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EPONYMS.

BY SIR D'ARCY POWER, K.B.E., LONDON.

XX. THOMAS'S HIP SPLINT (*continued*).

THOMAS'S hip splint seems to have been in use for about twenty years before Professor Rushton Parker, of Liverpool, seeing it by accident and at once appreciating its value, insisted that the inventor should publish an account of it. Thomas, as has been shown, had no vanity, no secretiveness, and above all no desire for publicity. He was wrapped up in his work, he always had more to do than was good for his delicate frame, and, as his involved style shows, he had but little skill with his pen. His disinclination to make his methods more widely known was due partly to want of time and partly to a modest belief that he had done nothing unusual by the invention of a splint which has revolutionized the treatment of fractures in bones and diseases in joints.

The first published account of the splint appears in *Diseases of the Hip, Knee, and Ankle Joints and their Treatment by a New and Efficient Method*, by Hugh Owen Thomas, Liverpool; published by T. Dobbs & Co., 69 Gill Street; 8vo, pp. iv and 101, illustrated with 17 plates. Messrs. Dobbs & Co. were a small firm of printers, friends of Thomas, and the book was practically issued privately at the price of ten shillings. It was dedicated to "my friend and respected fellow Townsman Dr. F. Ayrton as an acknowledgment though an inadequate one of many valuable services rendered to the Author." Dr. Ayrton had been resident medical officer at the Liverpool Fever Hospital and afterwards Lecturer on Medical Jurisprudence at the Liverpool School of Medicine. The Preface to the book is dated from 11 Nelson Street, Great George Square, Liverpool, July, 1875. A second and enlarged edition was published in 1876. I quote from the rare first edition, a copy of which is in the Library of the Royal Society of Medicine. Thomas writes at p. 18:—

"There is an opinion prevalent, that only gentlemen on the staff of our public charities can treat, with any chance of success, this affection [hip-joint inflammation] and certainly, hitherto, they have had advantages not possessed by the general practitioner, having at command the wealth of the

charity, to which they are attached, and being thereby enabled to order the costly appliances at present in use.

"Persons living at a distance from large towns, rarely receive professional assistance, as the one thing supposed to be needful cannot be obtained at home. This has induced me to describe such details, as will enable the surgeon to treat his cases at home, with no more mechanical assistance than can be rendered by the village blacksmith and saddler, and the poorer class of sufferers will, at a small cost, be assisted as effectually as the wealthier classes.

"We will suppose the patient, a boy of about 10 years of age, having been examined, and the affection diagnosed as disease of the right hip joint, the surgeon (*then*)* proceeds to measure him for the instrument (*suitable for a case in the early stage*). He requests the patient to stand on the left limb (the one supposed to be sound), and then places under the sole of the right foot a block or a book, one inch thick, telling him to rest the foot of the affected limb on it. If the spine is then straight he is ready to have the contour of the sound limb (*and portion of the trunk*) taken. If the spine is not of normal line, then add another block, or several blocks, (*if considered necessary*) until the unsound limb is raised sufficiently to allow the spine to resume its natural condition. Now take a long flat piece of malleable iron, one inch by a quarter for an adult, and three quarters of an inch by a quarter (*three sixteenths*) for children, and long enough to extend from the lower angle of the shoulder blade, in a perpendicular line downwards over the lumbar region, across the pelvis slightly external (*but close*) to the posterior superior spinous process of ilium, and the prominence of the buttock, along the course of the sciatic nerve to a point slightly internal to the centre of the extremity of the calf of the leg. The iron must be carefully modelled to this track, to avoid excoriations which would otherwise trouble the patient during treatment. (*In neglected and extreme deformities, under such conditions, the model is taken from the deformed limb, and, as the muscles relax the appliance is altered by aid of the wrenches. The lumbar portion of the upright must be invariably almost a plane surface, rotated on its axis more or less in proportion to the plumpness of the patient.*) This iron forms the upright portion. It is also very necessary that this upright should come below the knee, to enable the surgeon to fix this joint, otherwise the patient would flex the knee, and rising the leg as a lever, would strain the hip-joint. Then measure round the chest, a little below the axilla, deducting, in the case of an adult, three (*four*) inches from the chest circumference. This latter will be the measure for the upper cross piece, which is made from a piece of hoop iron, one and a half inch by one eighth of an inch. The hoop iron is firmly jointed with a rivet to the top of the upright. At one third of its length from the end next to the diseased side is the upper ring modelled to the outline of the trunk, which is oval in shape. It is important to give the upper crescent this oval shape, otherwise the machine will rotate from its position behind the body, also inversion of the limb will occur. Another strap of hoop metal five sixteenths (*three quarters*) of an inch by one eighth of an inch, and in length half (*two thirds*)

* The words here printed in italics appear in the second but not in the first edition.

the circumference of the thigh, is fastened to the upright, at a position from one to two inches below the fold of the buttock, according to the age of the patient, then another piece of metal of like strength, equal to half the circumference of the leg at the calf, is firmly rivetted to the lower extremity of the upright. The points of junction of the cross pieces with the upright should be out of centre. The short portion of the top half circle is next to the diseased side (*with a space intervening*), while the long portion must be closely fitted to the sound side. In my earlier experience the upper crescent (*a second crescent*) embraced the pelvis instead of the chest, but I found it very inefficient, difficult of application and painful to wear. (*If the machine should tend to rotate from the diseased side, then daily contract the long wing of the crescents, and expand the short ones; or should it tend towards the spine TOO FAR, then reverse this manipulation until the appliance becomes set in the correct position. In applying an instrument with two uprights, care should be taken to measure the distance between the tip of right and left posterior spinous processes, and then to set the uprights parallel and apart, one inch more than such measurement, or it cannot be tolerated by the patient. The two uprights should be connected by a crossbar, when practicable, which is not possible when the double instrument is used for reduction of deformities; this crossbar when used, will be found useful for the attendant to grasp in nursing. This appliance, with two uprights, is indispensable when both joints are affected, and if the patient or his friends do not object, will be found easier of application, and therefore of more certain efficacy, even in cases where only one articulation is affected.*)

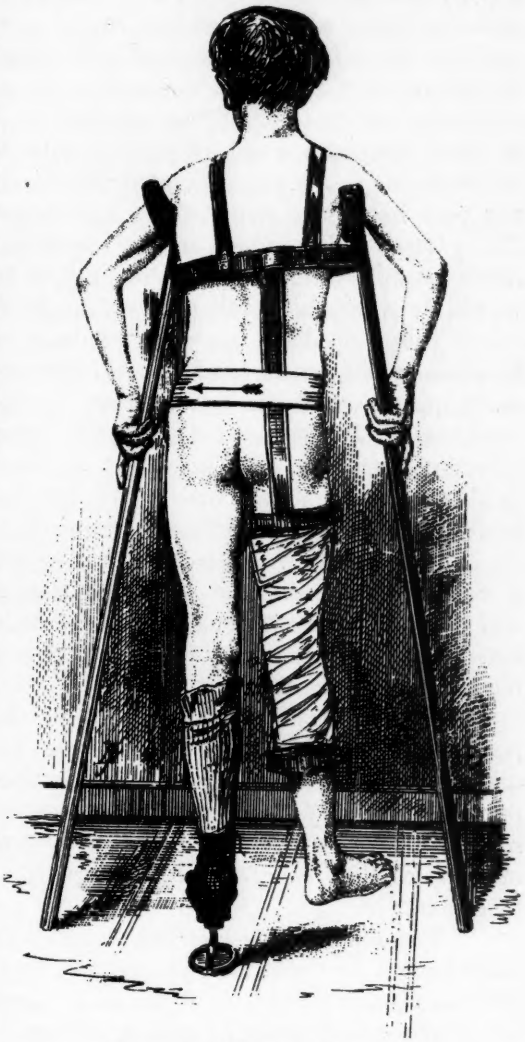

FIG. 404.—Thomas hip splint.

Reproduced from *Diseases of the Hip, Knee and Ankle-joints*, by Hugh Owen Thomas, Liverpool, 1875.

"The instrument is now ready to be padded and covered by the saddler with basil leather. (*The instrument is now ready to be padded and covered. The former is conveniently done with boiler felt* (*No.* 1 *thickness,*) *which should*

not be used in more than a single layer ; the latter is done by a saddler with basil leather. I recommend this quality of leather as it never becomes offensive with the patient's secretions, &c., which is the case with chamois leather so frequently used in the construction of surgical appliances.)

" However correctly it may have been modelled, it will often occur that some slight alteration will be demanded, when it comes to be applied to the patient, either on the first day, or at some period during the progress of the case, or the case may be one of long duration, uncontrolled, and consequently be attended with much deformity, then the surgeon may have weekly to alter the curves &c. of the appliance. To enable him to do this, I have devised and used a set of instruments and wrenches. By the aid of these the surgeon is always independent of any mechanical (cutler, &c.) aid until the case has terminated, or he may remodel an old appliance to use again. The patient being placed in the machine, a strap and buckle close the upper circle round the chest, and the limb is bound with flannel from the calf upwards, beyond the small crescent as is shown in *Fig.* [404]."

" When applied correctly the long portion of the upper crescent should be close to the trunk (*and should exercise some pressure on the sound side,*) the short portion a little space from the trunk. This is necessary to hinder rotation of the instrument, and the upright stem should have a perceptible rotation outwards, and be fitted so that it passes to the inner side of the popliteal space ; this will avoid rotation inwards of the limb, a defect easily avoided by attending to these details.

" (*Should the instrument rotate towards the diseased side, and so become a side splint, the surgeon should contract the longest wing of the upper crescent and expand the shorter one ; or if the instrument does not rotate, yet the stem is not over the prominence of the buttock and well behind the thigh, then the upright requires more twisting.*)

" It is advisable that the sufferer should be confined to bed for a short period, at the commencement of the treatment, until the night pains and disturbed sleep have ceased. This is the first stage of the mechanical treatment. (*It is preferable to place the patient in a soft bed, during the first stage, rather than on a mattrass, which is objectionable granting that the surgeon has not selected the iron of too slight proportion, an error I notice many are inclined to commit.*

" *The hip appliance if not moulded by the surgeon so as to remain continually behind the trunk, and painless to wear, then it requires more of the surgeon's skill and perseverance, or it would be useless to the patient. A few minutes of interruption is as great an evil as so many days, and would not be uninterrupted rest, which is so essential to success.*

" *It is very advisable that the sufferer should be confined to bed for a period, at the commencement of the treatment. This preliminary reclination, I have never noticed to injure the general health, but invariably improves the patient's condition, and shortens the acute stage. During the first stage of the mechanical treatment, the surgeon being satisfied that suppuration has been avoided, he permits the patient to proceed on to the second stage.*)

" Next comes the second stage. The patient is allowed to go about with the assistance of crutches, the frame continued, and an iron patten (*at least*

four inches in depth) placed under the shoe of the sound limb. This must be continued until the limb is well atrophied, around the great trochanter (*the outline of which should be more discernable than that of the sound side.*)

"We now come to the third stage. The patient takes off the framework in bed, and replaces it during the day, still using the crutch and patten for a certain period.

"We now arrive at the fourth stage. The patient discards totally the frame, and uses the crutch and patten only. These he sets aside after the surgeon is well satisfied of the permanence of the cure. If the case does not progress to the surgeon's satisfaction, some of these stages must be prolonged.

"The weight of the limb is equal to reducing any angular deformity of the lower extremity (*not resulting from true anchylosis*), and capable also, in a slight degree, of diminishing any shortening, should absorption of the head of the bone occur,—provided a suitable mechanical arrangement is applied (*and continued during a sufficient length of time*).

"The splint ought to be applied at once, whatever the stage of the disease. Forcible flexion, extension, tenotomy, or chloroform &c., are to be avoided as injurious (*unnecessary*). In the presence of this method, these operations are objectionable (*undesirable*), though they were essential at one time. Even should the deformity be an extreme one, no violence must be attempted; the limb must be gently persuaded to come back from the erring position, and as the limb assents, the wrenches should be used to alter the hip instrument towards the normal lines."

The persistence in treatment until there is wasting of the glutæus, and the *assenting* of the diseased limb, are curiously reminiscent of John Hunter's method of keen observation and thinking.

CHORIONIC CARCINOMA IN THE TESTICLE: WITH A REPORT OF A NEW CASE.

By R. M. HANDFIELD-JONES, London.

HISTORICAL SUMMARY.

The first recorded case of chorionic carcinoma in the uterus came from Sanger in 1889, followed independently by Pfeiffer in 1890. In view of the latter article, Chiari revised some of his previous cases and brought them into line with this new tumour. All these observers considered their specimens to be decidual sarcomata; but in 1895 Marchand first recognized their epithelial origin, and although he at first regarded the syncytium as maternal, he recognized later that it was of fœtal origin also.

To French pathologists belongs the honour of recognizing similar structures in the testicle, for in 1878 Malassez and Monod[34] reported a case, followed in 1898 by Carnot and Marie,[8] and in 1900 by Dopter.[14] In these cases the tissue attracting particular attention was the multinucleate giant-celled masses. They noticed the intimate relationship of these masses to the blood-vessels, and described the vacuolation with blood-corpuscles in the spaces. Though other cells were seen and described, little attention seems to have been paid them, and the tumour was considered to be of vaso-formative nature, and named the 'sarcome angioplastique'. Early in 1900 Wlassow[75] added four cases, and, reading his description in the light of modern knowledge, their classification as chorionic carcinoma presents no difficulty. In one of his cases the splenic metastases showed syncytium with ciliated borders, and in two of his cases typical areas of epiblastic and meso-blastic derivatives (cartilage, muscle, and squamous epithelium) were found, but because he could recognize no hypoblastic structure he refused to accept their teratomatous origin. Although he realized the close similarity between his cases and the chorionic carcinoma of the female, yet he failed to proceed to the logical conclusion, instead of which he named them 'epithelioma syncyomatodes testiculi'. It was with the ground thus well prepared for him, that Schlagenhaufer,[59] in 1902, finally placed these cases on a firm foundation. He pointed out the many features of these growths which exactly coincided with those seen in the uterine tumours, and going further maintained that they were all derivatives of a teratoma. He believed that such a teratoma contained rudimentary fœtal membranes which were responsible for the development of the chorionic carcinoma. This argument seems unfounded, and in later years Pick[48-53] has demonstrated its origin from a neuro-epithelial tube, and R. T. Frank[19] from an epithelial-lined cyst. Nevertheless, Schlagenhaufer's main contentions remain unquestioned to-day, and that the resemblance of these tumours to the female type is more than a superficial one is proved by the fact that in three recorded cases activity of the breast with colostrum secretion was a noticeable feature (Cooke,[12] Warthin[73] and Gabarini[77]).

FIG. 405.—Chorionic carcinoma of the testicle. One half of the testicle of the case reported. The body of the testicle is replaced completely by growth. The epididymis is normal. The cord is not infiltrated, but is enlarged from vascular hypertrophy. In the lower part of the growth is an area of blood clot, and it is around this that the best histological preparations of chorionic carcinoma have been obtained. ($\times \frac{2}{3}$.)

FIG. 406.—Secondary growths in the lung. This specimen is No. 754A in the Westminster Hospital Museum. The appearances are so exactly similar to the lungs of the author's own case that the latter were not drawn. Many of the nodules are seen to be typical plum-coloured areas, but in addition there are pinkish growths not infrequently seen in multiple metastases. ($\times \frac{2}{3}$.)

THE NAKED-EYE APPEARANCE.

The appearance will depend upon the amount of ordinary teratomatous structure present. If in any recognizable quantity it will present the typical picture with small cysts, areas of blue translucent cartilage, and so on. The area of chorionic carcinoma looks more like blood-clot than anything else. Plum-coloured areas are seen, practically homogeneous throughout, save for small, white, friable areas of necrosis. In my specimen (*Fig.* 405) the general appearance is that of a teratoma, but there is one area of blood-clot around which the best microscopic parts of the chorionic growth are to be found. In the fine specimen in the Westminster Hospital Museum the whole testicle is replaced by the reddish, plum-coloured growth, with a few strands of fibrous tissue. The metastases usually present the same red areas, but occasionally (*Fig.* 406) they are not stained with blood, and are then white homogeneous nodules.

THE MICROSCOPIC FINDINGS.

It is necessary to insist that the diagnosis of chorionic carcinoma depends upon the recognition of certain definite histological characteristics. There are several cases in the literature described as chorionic growths on quite inadequate grounds; there are preparations which arouse suspicion, but in which conclusive evidence is lacking. Again, of recent years certain observers, notably in France, have suggested that the diagnosis can be made in the presence of only one of the recognized elements of these chorionic growths. In the event, these cases may be regarded with suspicion, but no proof is present, and a confident diagnosis has no foundation. It seems desirable that the appearances in the testicle should be restated, for in no other organ does such unfortunate confusion exist as to the classification of malignant growths, and the issue can only be further confused if unwarrantable subdivisions of the chorionic carcinoma are allowed to creep in.

Marchand[35-38] has described two forms, the typical and the atypical, and he can hardly be improved upon. The following is the translation from R. T. Frank's[19] most admirable paper:—

"In the *typical* group the characteristics of the chorionic epithelium, which appears in the first stage of gestation, are represented with few or no variations. They show well-developed continuous syncytial masses of irregular multinucleated strands and branching protoplasmic buds, and with a more or less well-developed ground work of numerous transparent polyhedral cells of the nature of the Zellschicht (viz., Langhans' cells).

"In the *atypical* group, nearly everywhere the epithelium has lost its peculiar normal grouping, and occurs only in isolated cells which may be of various forms. The cell masses which form the surface and inner layers of the decidua basalis in a hydatidiform mole may be taken as an example or pattern of these forms. These cells rarely show the habitus of the delicate transparent, membranous, and often sharply circumscribed Zellschicht element with regular oval nuclei, frequent mitoses, and glycogenic cell protoplasm. More often they are compact, more deeply staining, and very irregularly shaped cells, with nuclei varying greatly in size, sometimes attaining enormous proportions and showing intense and often equal staining properties, which allow the recognition of their syncytial character. These elements may form multinuclear aggregates, but in many cases no large syncytial masses occur."

The elements found in chorionic carcinoma will be here briefly described. They are: (1) *The syncytium*; (2) *The Langhans' cells*; (3) *The chorionic wandering cells*; (4) *Masses of blood and fibrin.*

1. **The Syncytium.** — This consists of multinucleated protoplasmic masses of varying shape and size, and is often seen sending branching processes out into the surrounding tissues. The protoplasm stains deeply and is frequently vacuolated, red blood-cells often being seen in the vacuoles. In very well-fixed preparations the protoplasm takes on a greenish tinge with van Gieson stain, and the tint with hæmatoxylin and eosin is characteristic. The border of these masses is said to be ciliated—the stereocilia or *Bürstenaum* —but these are not true cilia. Under the high power the protoplasm often presents a foamy appearance, but this is believed to be due to commencing degeneration. The nuclei, of which there may be large numbers, are small, oval, and stain deeply and uniformly; but occasionally large spherical nuclei are seen which stain less deeply, have a definite nucleolus, and a well-marked chromatin network. Others again have no nucleolus, no chromatin network, but a series of chromatic

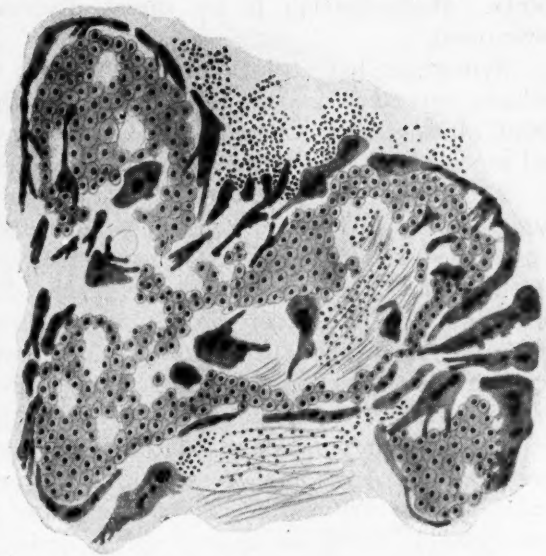

FIG. 407.—Drawing from Bonney's article showing the appearances of what Marchand would classify as a 'typical' chorionic carcinoma. (Copied by kind permission from Mr. V. Bonney.)

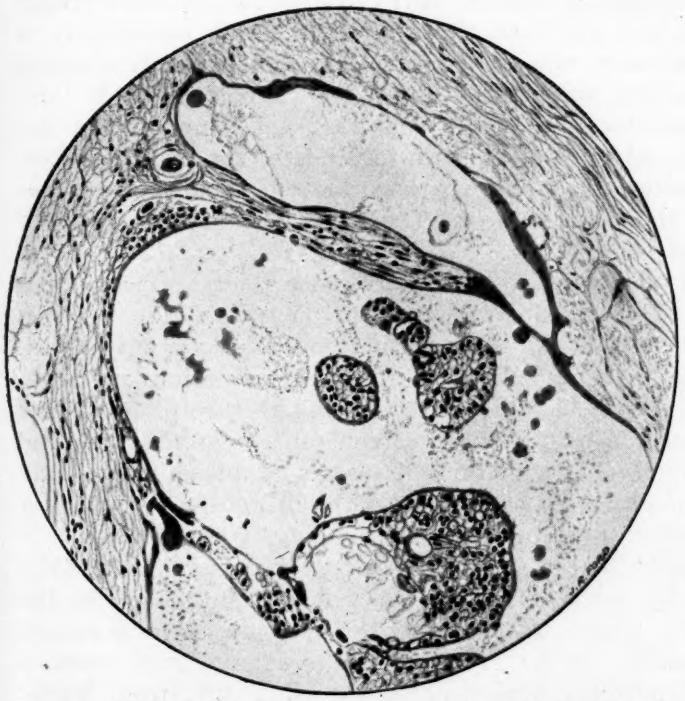

FIG. 408.—Low-power drawing of an area seen in the reported case, in which there appears to be an attempt at the formation of chorionic villi. Flat strips of syncytium may be seen in several parts of the section, and in the centre are two masses of Langhans' cells surrounded by a very fine zone of syncytium. (× 75.)

points. Multiplication is by direct division, and karyokinetic figures are never seen.

Syncytium has an intimate relationship to blood capillaries, and in many sections vascular channels may be seen in the process of erosion by the syncytial masses. This results in large areas of blood extravasation as more and more blood-spaces are opened up. (*Figs.* 407–410.)

2. **The Langhans' Cells.**—These are medium-sized polygonal cells with single nuclei. The cytoplasm is less dense than that of the syncytium, and generally presents a fairly clear appearance. It is very finely granular, has a wide reticulum, and does not stain deeply. The cell outline is well defined and sharp, but when present in bulk they show signs of pressure. The nuclei are larger than those of the syncytium and have a well-marked chromatin network with one or two nucleoli which stain well with nuclear stains. Multiplication is by indirect division, and karyokinetic figures are quite commonly seen. Fresh preparations sometimes when stained with Sudan III show the presence of fat, and special methods have proved that glycogen is sometimes found in these tumours. These Langhans' cells vary considerably in their arrangement, at times appearing as masses of cells mimicking a carcinoma simplex, at others lining tubules, cystic spaces, or papillary tufts.

3. **The Chorionic Wandering Cells.**—These seem to be a compromise between the two previous types. They may be mono- or multinucleated. If the former they are larger than the Langhans' cells, and if the latter they are smaller than the syncytial masses. Again, their cytoplasm stains more deeply than the Langhans' cells and less than the syncytium. The nuclei have a well-marked nuclear membrane, one or two nucleoli, and a deeply staining chromatic network. Division may be by direct or indirect methods, and according to Teacher both forms may occur in the same tumour. In the uterus these cells occur in advance of the growing edge of the main growths, and according to some authors they—rather than the syncytium—are responsible for the erosion of the blood-vessels. The exact nature and origin of these cells are quite unknown.

4. **Blood and Fibrin.**—In every chorionic carcinoma there are large areas of blood-cells in various stages of degeneration, tumour-cells dead or dying, and fibrin formation is well marked. In the outermost layers of such areas, tumour-cells may be seen with nuclei and showing fragmentation, pyknosis, and other signs of degeneracy. In some specimens this picture predominates almost throughout, and only after prolonged search can a reasonably typical area of growth be identified. This picture of masses of blood, fibrin, and necrotic tumour-cells is undoubtedly suggestive of the diagnosis, but it is not sufficient, and a typical area must first be seen.

In the testicle in a very large majority of the reported cases (*see* p. 617), teratomatous structures appeared either in the primary growth or in the metastases, and I strongly incline to the view that they do not and cannot occur in the testicle save as part of a teratoma. Again, examples are recorded which follow exactly Marchand's typical form (*see Fig.* 407, from Victor Bonney's article: nothing more typical could be needed). In some parts my tumour is absolutely typical. In other cases the arrangement is atypical, and one or other cell form may predominate. In the testicle it must be

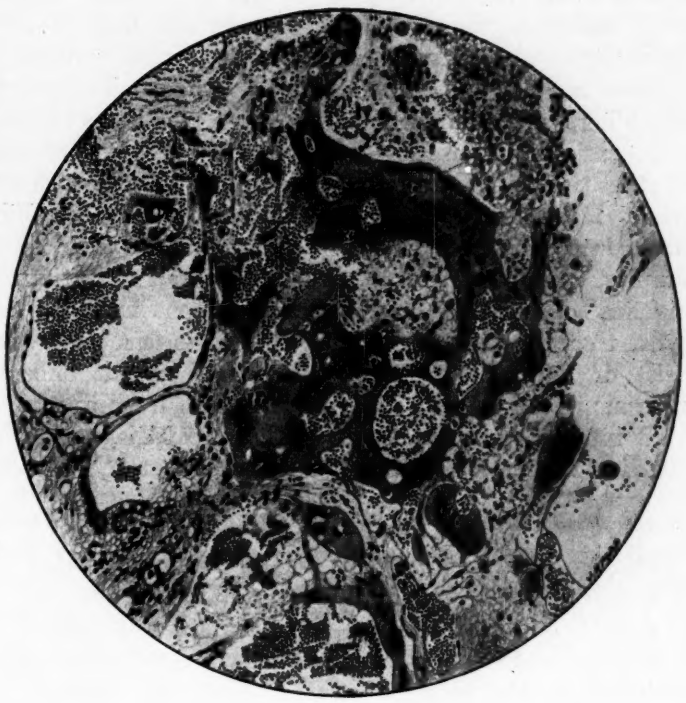

FIG. 409.—Low-power drawing from the same tumour. The centre of the section contains a branching mass of syncytium, with many small, round, and darkly staining nuclei. Vacuoles of varying size are seen filled by red blood-cells. The granular or foamy appearance is well seen. At the upper right and lower left parts of the drawing are Langhans' cells. (Hæmatoxylin and eosin.) (× 90.)

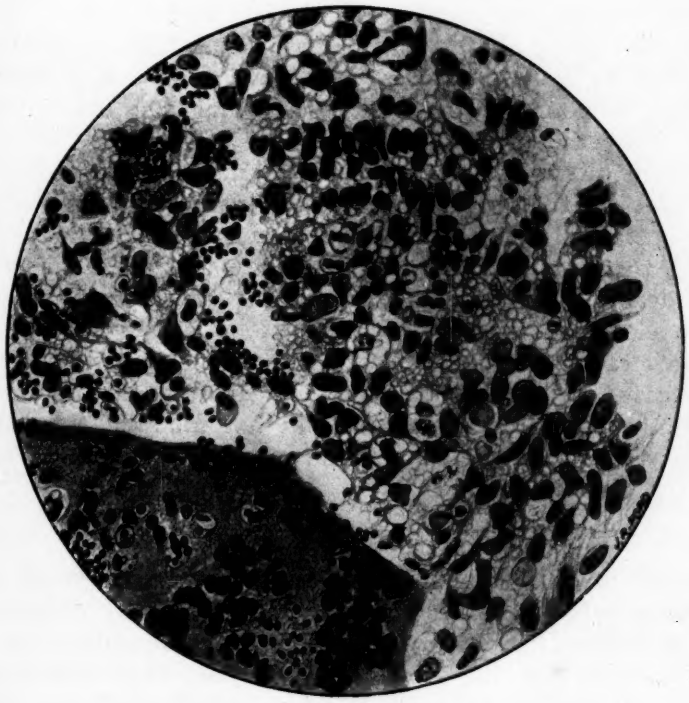

FIG. 410.—A higher magnification of the upper right-hand edge of the syncytium in *Fig.* 409. The character of the Langhans' cells is more clearly seen. Several mitoses are present. (Hæmatoxylin and eosin.) (× 270)

accepted that the tendency is for these growths to be extremely atypical, and in many sections one or other element may alone be represented, and only by tracing direct continuity with a more typical area can a clear-cut diagnosis be given. And this raises a most important question. In such areas, where only one element is seen—e.g., a mass of Langhans' cells simulating a carcinoma simplex—is it possible by any histological method to say that the tissue in question is definitely of a chorionic character? Quite recently Hartmann and Peyron[80] have divided chorionic carcinomata in the testicle into two groups, viz., placentomata, which they describe as typical examples, and choriomata, which show no syncytium and only masses of Langhans' cells which by their arrangement mimic a carcinoma simplex. I suggest that they have brought forward no acceptable proof that these latter consist of Langhans' cells at all, and I submit once again that this is a dangerous doctrine, and liable to lead to a fresh avenue down which we may be led into worse mistakes in pathological diagnosis and a still more complicated classification of malignant disease of the testicle.

THE METASTASES.

Chorionic carcinoma gives widespread metastases via the blood-stream, and usually this occurs at an early date. When the peculiar character of this growth is borne in mind—its intimate relationship with, and erosion of, the blood-vessels—its early dissemination is easily understood. The lungs invariably are the principal seat of secondary deposits, and later there may be a generalized distribution throughout the body. It is usual for the secondary nodules to show the same characteristics as the primary tumour, but occasionally small deposits are seen free of blood, and are then firm, white growths. They commonly show a much more typical histology than the parent growth, and in some instances they have settled a doubtful diagnosis of the primary tumour. *Fig.* 408 shows the lung of a case in the Westminster Hospital Museum.

Though blood-stream dissemination occurs early and in severe degrees, this tumour also spreads by the lymphatics, and enlarged glands are commonly seen along the aorta and inferior vena cava near the renal vessels. In the case now reported, the lymphatics running into the pelvis parallel to the vas deferens were permeated by growth. This path of spread is by no means uncommon, as I have shown elsewhere.[78]

There is one feature of the greatest clinical interest with regard to these metastastes. Certain cases are recorded of chorionic carcinoma of the uterus in which spontaneous repression of the secondaries has followed the local removal of the primary growth. As far as I am aware, no similar record exists in the testicular growths.

THE SITE OF ORIGIN.

In the early history of this tumour many theories were advanced to explain its origin; since Schlagenhaufer finally demonstrated its chorionic character, the main discussion has centred around the actual element in a teratoma that is responsible for the trophoblastic tissue. The following, briefly summarizes the various theories: (1) Malassez and Monod[34] regarded

it as a vasofactive endothelial sarcoma. (2) Sternberg[68] has recently revived the endothelial theory. (3) Monckeberg[42] also assigns an endothelial origin to the syncytium. (4) Conforti[11] suggests it is a perithelioma. (5) Schlagenhaufer[59]—from fœtal membranes in a teratoma. (6) Lubarsch—a metaplasia of embryonic ectoderm in a teratoma. (7) Pick,[48] Risel,[57] and Frank[19] have shown it arising from such derivatives of a teratoma as neuro-epithelium, cubical and squamous epithelium.

The generally accepted view is that it arises from some element in a teratoma, but that the formation of true fœtal membranes is not necessary. Schlagenhaufer's theory fails for two reasons: first, no structure in a teratoma testis has ever been described as representing fœtal membranes; and, secondly, it is logical to assume that, if such membranes did exist, they should give rise to the same series of tumours that are known in the uterus, viz., the benign hydatidiform mole and the perforating hydatidiform mole, as well as the actual chorionic carcinoma. His very interesting theory would therefore become established if hydatidiform mole formation could be proved in these tumours. Five cases have been claimed as providing this proof by Breuss and Schlagenhaufer,[6, 59] Waldeyer, Silberstein and Kanthack and Pigg.[81] These cases are not accepted by pathologists as a whole, and Schlagenhaufer's theory as yet remains unproved.

The histological descriptions from Pick, Risel, and Frank are similar in that chorionic carcinoma has been seen in continuity with the lining membrane of certain cysts. In one case it was a neuro-epithelial tube, and in the other two cysts lined by squamous and cubical epithelium respectively. To claim that the chorionic tissue has definitely arisen from these different epithelia seems unjustifiable and contrary to the general histology of the teratomata. It is one of their characteristics that various tissues are jumbled up in a heterogeneous mass, and it is one of their commonest features to contain a cyst lined in one place by tall columnar epithelium, in another by squamous, and in yet another by low cubical, each type passing gradually or abruptly into the next. If chorionic tissue is present, it is only too likely to be found mixed up with other elements, and it is known to line cysts, part of which may be lined by another type of cell.

In the present stage of our knowledge—or rather ignorance—of the origin of the teratomata themselves, it is not possible to be assured of the finer details of their derivatives. It is enough say that there remains little doubt that the chorionic carcinoma does not arise in the testicle apart from a teratoma, and that, until time affords a proof of Schlagenhaufer's theory, we must remain content with this limited knowledge. In this paper I have described areas in the original tumour, and particularly in the cardiac metastases, which bear a striking resemblance to true chorionic villi, but I should hesitate long before considering them as proof of their origin from pre-existing fœtal membranes.

ACTIVITY OF THE BREASTS.

Attention has recently been drawn to the activity of the male breast in connection with chorionic carcinoma of the testicle. Cases have been recorded by Cooke,[12] Warthin,[73] and Gabarini.[77] In each patient the breasts enlarged

and colostrum was secreted. It is a striking proof that these tumours bear a more than superficial resemblance to the chorion of pregnancy. Further, they shed an interesting light on the possibility that the teratoma may have a far-reaching influence on the general metabolism of the patient. For example, it is a somewhat intriguing thought that thyroid tissue in a teratoma may be present in such quantity as to produce a clinical hyperthyroidism.

THE AUTHOR'S CASE.

T. W., age 40, married, a tobacconist, who had lived for several years in Australia, presented himself in the middle of April, 1925, in the out-patient department of St. Mary's Hospital, complaining of a swelling of the right testicle.

History.—During October, 1924, in Australia, he noticed a swelling of the right testicle, which came on quite rapidly and was accompanied by slight dragging pain in the right lower part of the abdomen. Within a few weeks he saw three practitioners, who, not believing his assertion that he had never had gonorrhœa, overhauled him with a view to establishing this diagnosis. By each he was urethroscoped, his prostate was massaged, urine examined, and numerous bacteriological examinations were made. In no instance were gonococci to be seen. The only treatment of any sort suggested was that of radiant heat to the enlarged testicle. Dissatisfied, he sailed for England and came straight away for advice. He told me after admission to the wards that he had had blood-stained sputum daily for many weeks, even while under medical examination in Australia.

On Examination, he had a spherical swelling of the right testicle, perfectly homogeneous, firm but not very hard (*see Fig.* 405). The cord was definitely enlarged, but the vas was not thickened. The scrotal skin was red, but not fixed to the tunica vaginalis. No hydrocele was present. Rectal examination showed no abnormality of the prostate or vesicles; but a large mass was felt in the epigastrium, fixed to the posterior abdominal wall. The diagnosis of malignant disease of the testicle with lymphatic dissemination was clear.

The man expressed a great desire to get rid of the tumour, and he was consequently admitted to the wards on May 2, 1925. He then told me of his hæmoptysis, and he coughed up blood each day in hospital. Clinical and radiographic examination showed unmistakable evidence of lung involvement, and he was consequently told that nothing could be done. His brother asked for an unrestricted statement of prognosis, and six months was the period given him. After discussion with the brother, the patient begged me to remove the testicle, as he wished to be rid of the discomfort and pain for what was left of his time. The testicle was accordingly removed through the inguinal canal. He recovered rapidly from his operation, and made preparations for departure to Dublin, where he was going to have deep radiotherapy to the lumbar glands and chest. He was therefore discharged from hospital.

During the last week in June he became suddenly much worse and was re-admitted. It was evident that a fatal issue was but a matter of days, and he died on July 10.

POST-MORTEM.—The examination revealed the following findings :—

Lungs.—Both lungs were riddled with metastases, the left lung being worse affected. *Fig.* 406 shows a very similar picture, but in my case there was much less normal-looking lung. The left pleural cavity contained a straw-coloured fluid in some quantity, and there was a fibrinous pleurisy, with adhesions at the back at the level of the hilum.

Heart.—The superior mediastinum was full of growth which had spread around and enveloped the heart. The muscle and cavities were normal, except for one extremely interesting metastasis. The Eustachian valve was larger than usual and fenestrated, and growing from its margin were several nodules of growth. Many small nodules were present on the contact margins of the tricuspid valve.

Liver.—Contained one large secondary nodule, and was the only one in the whole post-mortem examination to give a good histological picture. In all the others necrosis was too advanced. In this nodule the histology is absolutely typical.

Intestines, Spleen, Kidneys.—All free of growth.

Lymphatic System.—A huge mass of affected glands was found on and between the aorta and superior vena cava about the level of the right renal vessels. Also a small collection on the external iliac vein, and a very definite chain of secondary nodules along the lymphatic running parallel to the vas into the pelvis. Scattered all over the peritoneum of the lateral wall of the pelvis were numerous milk spots of growth connected by a fine white tracery of lymphatics.

MICROSCOPIC FINDINGS: *Testicle.*—Dr. W. D. Newcomb, Pathologist to St. Mary's Hospital, was present at operation, and received the specimen straight from the operating table. Several pieces were immediately taken for special fixation to enable us to stain for glycogen. One half of the specimen was kept intact and put through the usual Kaiserling process. The other half was cut entirely into blocks and fixed in various ways—formol saline, uranium nitrate, formol alcohol, and Ziegl Wallner—and in all thirty-four blocks were prepared and cut.

Apart from the chorionic carcinoma, other teratomatous elements were few and far between, and consisted of a few scattered islands of cartilage and some cysts lined by columnar and by cubical epithelium. The chorionic carcinoma was present in widespread areas. Despite the naked-eye appearance of the tumour, necrosis was not marked, and in only three of the blocks cut did we fail to see this tissue, and in most of them it was present not only in abundance but in such good fixation that it was not easy to settle which field should be selected for drawing. *Figs.* 409 and 410 are low- and high-power drawings of easily recognized areas. Masses of vacuolated, granular syncytium are present, and many typical Langhans' cells with mitoses also. *Fig.* 408 shows a rather different appearance, a much more orderly arrangement than that seen in *Fig.* 409. Here there does seem to be an attempt to form true chorionic villi. The attempt is not really successful, but the picture is very suggestive. It may be that if anyone is fortunate enough to remove a really early chorionic tumour, such as this in October, 1924, then there will be found typical chorionic villi, and a long step forward towards the proof of Schlagenhaufer's theory will have been taken.

Fig. 411 illustrates the appearance of quite a small area in the tumour. This appears only in one block cut, and in only a corner of that. It is an ordinary adenocarcinoma of a regular arrangement, such as is not often seen in testicular tumours. There is not the slightest evidence to suggest that the cells here lining the acini are anything to do with Langhans' cells, and presumably they are another derivative of the original teratoma.

Only those metastases in the *liver* and the *heart* contained really good histological material. The remainder were all in an advanced stage of necrosis. That in the liver showed a typical arrangement of chorionic tissue as seen in the original tumour. The growth in the heart is of the greatest interest, in that it is composed of numerous villi, being more highly suggestive of true villi than any section I have seen previously. There are also tubules lined by columnar epithelium, representing other teratomatous elements.

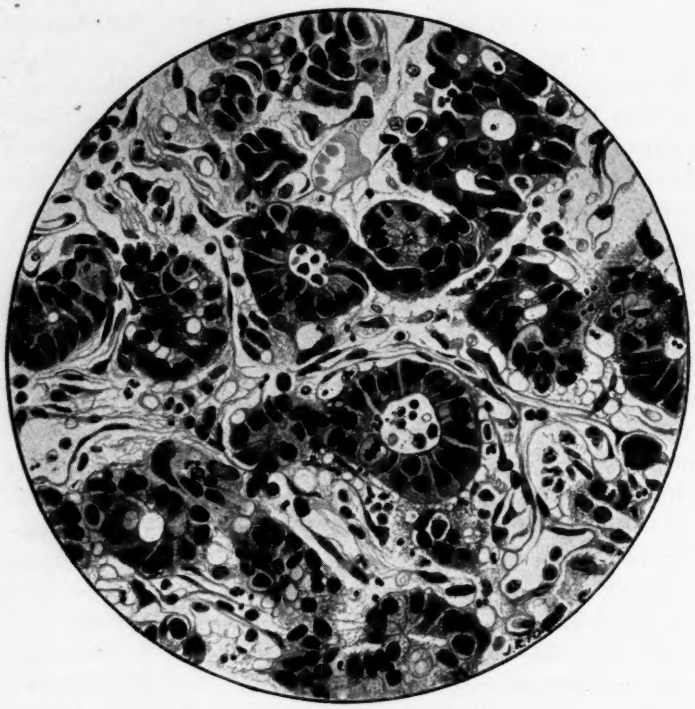

FIG. 411.—A high-power drawing of a small area in the same tumour, showing an adenocarcinoma. The tubule formation is well seen, and two mitotic figures are present. There are a large number of polymorpho-nuclear leucocytes scattered throughout the section. (× 300.)

In conclusion, it is with great pleasure that I acknowledge my indebtedness to Dr. Newcomb for his help and advice. My thanks are due to Dr. Braxton Hicks, Pathologist to the Westminster Hospital Museum, for access to his material, and his very kind permission to have his specimens drawn. Sir Bernard Spilsbury has most kindly given me a personal communication of a hitherto unpublished case of his own, and Dr. Shore, Curator of the St. Bartholomew's Hospital Museum, has shown me the sections of a tumour in his collection. To them I offer my sincere thanks. And, finally, I am indebted to Mr. Thornton Shiells and Mr. Ford for their admirable drawings. *Fig.* 407 is a copy of a drawing in Mr. Victor Bonney's paper, and I am greatly indebted to him for his permission to use it.

LIST OF REPORTED CASES OF CHORIONIC CARCINOMA.

Woglom in 1917 brought the list up to 69. I have now further brought this up to date with 40 cases, making 109 in all.

No.	Reporter	Age	Side	Duration	Result	Other Teratomatous Elements		Remarks
						Tumour	Metastasis	
				Ms.				
1	Malassez and Monod[34]	27	L	12	D	No	No	Other teratomatous elements not looked for
2	Carnot and Marie[8]	37	L	10	D	No	No	—
3	Dopter[14]	28	R	6	D	No	No	—
4	Wlassow[75]	—	—	—	—	No	?	No clinical data
5	Wlassow	—	—	—	—	No	?	No clinical data
6	Wlassow	—	—	—	—	Yes	?	No clinical data
7	Wlassow	—	—	—	—	Yes	?	No clinical data
8	Schlagenhaufer[59] ..	43	L	?	D	Yes	No	—
9	Breuss and Schlagenhaufer[6]	40	R	2½	D	Yes	No	Interpreted as hydatidiform mole
10	Carey[7]	?	?	?	?	Yes	No	No clinical data
11	Schmorl and Steinert	22	L	9	D	Yes	Yes	—
12	Schmorl[60]	17	?	?	?	Yes	?	—
13	Steinhaus[67]	32	L	6	?	Yes	?	—
14	Risel[57]	20	L	?	?	?	?	—
15	Risel	35	?	?	D	?	Yes	Original growth not examined
16	Emanuel[15]	26	L	4	D	Yes	?	Atypical forms present
17	Westenhoeffer[74] ..	30	?	?	D	Yes	Yes	—
18	Chevassu[9]	30	L	3	?	No	?	—
19	Hansemann, A.[24] ..	28	R	?	?	?	Yes	Original tumour not examined
20	Astanazy[1]	24	R	12	D	No	?	Atypical forms present
21	Sternberg[68]	26	R	14	D	No	No	—
22	Scott and Longcope[61]	45	R	2	D	No	No	Undescended testicle
23	Dillmann[13]	32	L	4	D	Yes	No	—
24	Frank, R. T.[19] ..	40	?	24	?	No	?	—
25	Frank, R. T. ..	16	L	2	?	Yes	?	Atypical forms present
26	Spilsbury[64]	28	?	2	?	Yes	?	—
27	Hicks[26]	30	R	12	?	Yes	?	—
28	Lawrence[33]	?	?	?	?	Yes	?	—
29	Reinhold[55]	30	R	7	?	Yes	?	—
30	Bernstein[3]	34	L	4	D	No	No	—
31	Bernstein	29	R	?	D	No	No	—
32	Bonney[5]	?	?	?	?	No	?	—
33	Bonney	?	?	?	?	Yes	None	—
34	Orton[47]	38	L	5	D	No	No	—
35	Monckeberg[42] ..	19	L	10	D	No	No	—
36	Monckeberg	34	R	?	?	No	?	—
37	Monckeberg	Young	?	?	D	Yes	No	—
38	Nicholson[44]	30	R	?	D	?	?	—
39	Nicholson	20	L	9	D	Yes	?	—
40	Nicholson	25	L	24	D	Yes	?	—
41	Chervin[10]	20	R	6	D	No	No	—
42	Jean and Massabuan[28]	44	R	12	?	Yes	?	—
43	Fischer[17]	43	R	?	D	Yes	Yes	Undescended testicle
44	Ohkubo[45]	26	R	12	?	Yes	?	—

LIST OF REPORTED CASES OF CHORIONIC CARCINOMA—*continued.*

No.	Reporter	Age	Side	Duration	Result	Other Teratomatous Elements		Remarks
						Tumour	Metastasis	
				Ms.				
45	Ohkubo	23	R	?	?	Yes	?	—
46	Ohkubo	45	R	10	D	?	Yes	Primary not examined
47	Taylor[70]	28	L	8½	D	Yes	No	—
48	Fink[16]	35	?	?	D	No	?	—
49	Klippel and Monier-Vinard[31]	?	?	?	D	Yes	Yes	—
50	Gruner[22]	25	L	5	?	Yes	?	—
51	Glaserfield[21]	23	L	30	D	Yes	No	—
52	Sigl[62]	34	R	6½	D	No	No	Several congenital abnormalities
53	Launois, Masson, and Pinard[32]	40	L	12	D	?	No	Primary not examined
54	Kaufmann[29] ..	43	?	?	D	No	No	—
55	Conforti[11]	46	L	30	D	No	No	—
56	Zenoni	32	R	?	D	No	No	—
57	Marcora[39]	29	L	12	D	Yes	?	—
58	Keenan[30]	20	R	7½	D	No	No	Epididymis only
59	Hahn[23] (Boestrom)[4]	40	?	7	D	?	No	B.'s case reviewed by Hahn
60	Tirumurti[71]	35	R	2	D	No	No	Undescended testicle
61	Frank, A.[18]	30	L	2	?	Yes	?	—
62	Meyer, R.[40]	23	L	14	D	Yes	No	Primary contained no chorionic epithelioma
63	Roncali[58]	18	L	10	D	Yes	?	—
64	Boncali	Young	R	?	D	Yes	?	—
65	Warthin[73]	35	R	?	D	Yes	No	Hyperplasia of breast
66	Fritze[20]	21	L	2	D	Yes	Yes	Metastasis pure chorionic epithelioma, primary none
67	Cooke[12]	26	R	?	D	None	None	Hyperplasia of breast
68	Woglom[76]	?	?	?	?	Yes	?	No clinical data
69	Woglom	35	R	19	D	Yes	No	—
70	Jackson[27]	23	R	36	D	Yes	Yes	—
71	Ooman[46]	—	—	—	—	—	—	—
72	Hedinger[25]	29	R	—	D	Yes	Yes	—
73	Volkmann[72]	4	R	6	D	Yes	?	No post-mortem allowed
74	Reckendorf[54] ..	24	R	24	D	Yes	Yes	—
75	Tanner[69]	—	—	—	—	—	—	—
76	Richey[56]	—	—	—	—	—	—	—
77	Spremolla[65] ..	—	—	—	—	—	—	—
78	Spilsbury[63]	33	L	?	D	Yes	Yes	Chorionic tissue seen only in metastases
79	Handfield-Jones ..	40	R	7	D	Yes	Yes	—
80	Handfield-Jones (Spilsbury's case)	—	—	—	D	Yes		—
81	Handfield-Jones (St. Bartholomew's Hospital Museum)	No details available.						—
82	Dew[82]	35	L	16	D	Yes	?	Metastasis was not examined
83–109	Hartmann and Peyron[79] published 27 cases, some of which are not original. New cases not stated.							

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THE NERVES OF THE STOMACH AND THEIR RELATION TO SURGERY.*

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INTRODUCTION.

The advance of physiological knowledge and the increasing connection between physiology and surgery provide the justification for this paper on the stomach and its nerves. Recent advances in the physiology and pathology of these nerves indicate the application of this knowledge to gastric surgery. No attempt has been made to cover the whole field of the literature, and for further details readers are referred to the papers of the authors quoted.

Few will assert that gastric surgery is at the present time in a condition of stability, or rather of comparative stability. As an example, it is only necessary to call attention to the gradual decay of gastrojejunostomy as a routine procedure, first for gastric ulcer and secondly for duodenal ulcer; British surgeons are, however, not so dissatisfied with this operation for juxta-pyloric ulcer as are many surgeons abroad. The marked divergence of opinion with regard to the correct treatment of gastric ulcer is also indicative of an unsatisfactory condition of affairs. Furthermore, surgery fails to relieve or indeed even to treat certain disorders, well known to the clinician and radiologist, which are manifested by gastric signs and symptoms.

For a number of years investigators have endeavoured to determine the relationships existing between the nerves of the stomach and gastric ulcer. The nerves have been studied as a cause of ulcer, as factors productive of the various complications and sequelæ, and as possible sources of cure or prevention. They have also been considered as affording a means whereby surgery may approach the 'nervous dyspepsias'. The writings of Exner, Eppinger and Hess, Bircher, Latarjet, and more recently of Schiassi, are of especial interest in this connection; their work will be referred to in some detail in the following pages.

It may be stated that only two conditions of the stomach and duodenum are submitted to surgical treatment; these are 'peptic' ulcer and neoplasm, their complications and sequelæ. It is also true that many of the routine operations upon the stomach are mutilating in the extreme, and often out of all proportion to the lesion present, whilst but scant respect is paid to

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* Embodying a paper read before the Manchester Surgical Society, March 24, 1925.

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physiology. Indeed the recent trend appears to be in the direction of more and more mutilating procedures which are only "limited by the powers of recovery of the patient and the resources of technique".

A conclusion reached both from the clinical and radiological standpoints is that, by the present methods, truly satisfactory results are obtained only when definite retention due to organic disease exists. Ryle states that "no attempt should be made to circumvent mechanically a lesion which is producing no considerable mechanical disturbance of function". The suggestion is made that only in definite organic obstruction and in tumour are the results of operation at all justified.

Medicine has covered a wider field than surgery, and the treatment of certain of the alleged non-surgical conditions by means of drugs which act on the nervous mechanism, e.g., atropine, has not been without considerable success. This is, however, often only temporary, and may be associated with undesirable general effects; therefore the hypothesis is put forward that approximately similar results which will be both permanent and local may be obtained by recourse to surgery.

Almost any remarks upon the surgery of the stomach at once lead one into a maze of controversy in which endless side-issues arise to obscure the main discussion. It is my endeavour in this paper to show that operative interference with the nerves of the stomach is both feasible and in certain instances justifiable. It is hoped that the following review of our knowledge of the anatomy and physiology of the nerves, together with some account of their pathology and surgery, may demonstrate the foundations upon which such operations are based and indicate in what directions they may be applied. Those operations which have already been applied to man are described, and operations are suggested by which it is hoped that the conditions referred to under the names of cardiospasm and pylorospasm may be relieved.

ANATOMY OF THE NERVES.

Modern text-books of anatomy devote but little space to the anatomy of the nerves of the stomach, and are often inaccurate. It is therefore necessary to consider the nerve-supply and its distribution. The anatomy of the vagus and sympathetic supply to the stomach and neighbouring organs has been described in particular by Swan, Kollmann, Perman, Latarjet, and McCrea. The arrangement of the nerve branches has been shown to be of remarkable constancy.

Vagus.—It is commonly stated that the left vagus is distributed to the anterior surface of the stomach, the right to the posterior. This is not the case; each vagus sends fibres to both surfaces of the organ. This is evident from the structure of the œsophageal plexus, and from the fact that stimulation of a single vagus in the neck will cause movements of the whole stomach.

The œsophageal plexus is not a meaningless network of nerves, but is a very simple plexus, having a constant basic structure. From it two trunks, anterior and posterior, arise, which may, however, each be represented by two branches. Each vagal trunk contains fibres of both vagi, and I have confirmed this by degeneration methods in the cat. The chief vagal branches

lie along the lesser curvature, but do not reach the pylorus; this receives its nerve-supply from above, from the hepatic branch of the anterior vagal

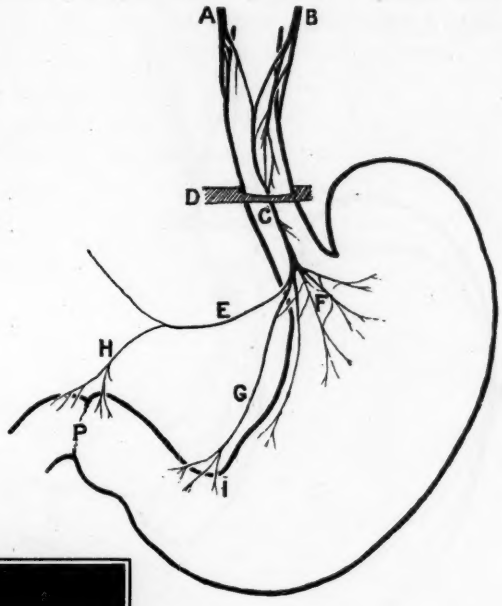


FIG. 412.—Drawing made from a dissection showing the normal formation and distribution of the anterior vagal trunk. A, Right vagus; B, Left vagus; C, Anterior vagal trunk; E, Hepatic branch; F, Gastric branches; G, Principal anterior nerve of the lesser curvature; H, Branches to pylorus and first stage of the duodenum; P indicates the position of the pylorus, I that of the incisura angularis, and D the diaphragm.

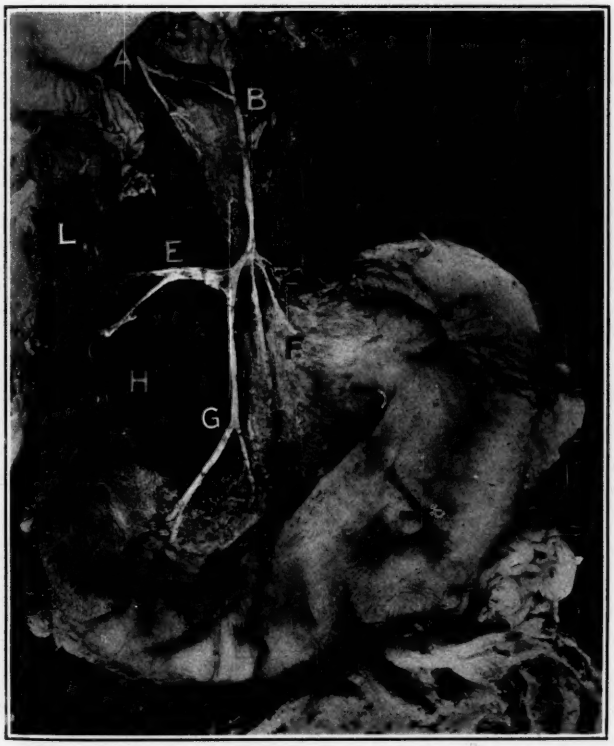


FIG. 413.—Photograph of a dissection illustrating the formation and distribution of the anterior vagal trunk. A, Right vagus; B, Left vagus (anterior branches); C, Anterior vagal trunk; D, Communication from right to left vagus; E, Hepatic branch; F, Gastric branches; G, Principal anterior nerve of the lesser curvature; H, Branch to pylorus and first stage of the duodenum; L is placed on the cut surface of the liver, the left lobe of which has been removed; P indicates the position of the pylorus.

trunk, which crosses high up in the gastrohepatic omentum to reach the porta hepatis. The first stage of the duodenum is supplied in the same manner as the pylorus (*Figs.* 412, 413).

The posterior vagal trunk supplies a large branch to the cœliac plexus and thus to certain of the abdominal organs, including the pancreas, kidneys, and small intestine. Its gastric division does not reach the pylorus (*Figs.* 414, 415).

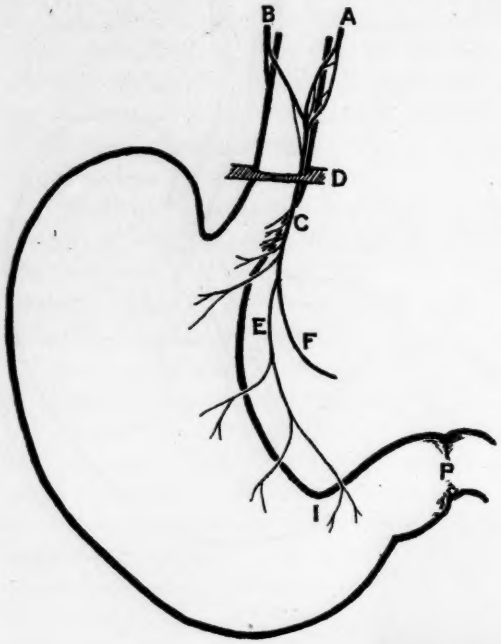


FIG. 414.—Drawing made from a dissection illustrating the normal formation and distribution of the posterior vagal trunk. The stomach has been turned to the right, exposing the posterior surface. A, Right vagus; B, Left vagus; C, Posterior vagal trunk; E, Gastric division, which lies in the coronary falx; F, Cœliac division; P indicates the position of the pylorus, I that of the incisura angularis, and D the diaphragm.

FIG. 415. — Photograph of a dissection showing the formation and distribution of the posterior vagal trunk. A, Branches of right vagus; B, Branches of left vagus; C, Posterior vagal trunk; E, Gastric division; F, Cœliac division; G, Principal posterior nerve of the lesser curvature; P indicates the position of the pylorus, and I the site of the incisura angularis.

Sympathetic.—The sympathetic fibres are all derived from the splanchnic nerves, and take origin from the cœliac plexus. The majority of the nerve twigs accompany the branches of the cœliac artery, though a few run with the inferior phrenic arteries. Thus the main nerves associate themselves with the left gastric or coronary artery, and are reinforced in the neighbourhood of the cardia by twigs which accompany the inferior phrenic arteries. Other branches run with the hepatic artery, chiefly to the liver, but twigs descend from these to the pylorus and first stage of the duodenum, passing between the layers of the hepatoduodenal ligament and right margin of the gastro-hepatic omentum; some fibres pass with the right gastric or pyloric artery and the right gastro-epiploic artery to the stomach (*Fig.* 416).

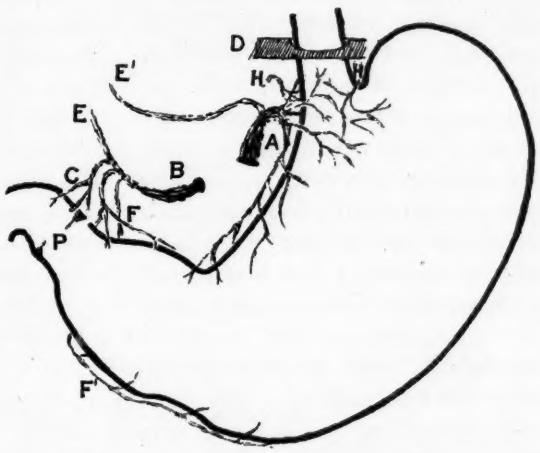


FIG. 416.—Drawing to illustrate the manner of distribution of the sympathetic nerves to the stomach. A, Nerves accompanying and distributed with the left gastric or coronary artery (a similar arrangement exists on the posterior surface of the stomach); B, Nerves accompanying the hepatic artery; C, Branches which run a recurrent course in the right free margin of the lesser omentum and with the right gastric or pyloric artery to supply the pars pylorica and duodenum; E, E′, Nerves to the liver; F, F′, Twigs running with the gastro-duodenal artery and its gastro-epiploic branch; H, H, Twigs with the inferior phrenic arteries. P indicates the position of the pylorus, and D the diaphragm.

Intrinsic Nerves.—The intrinsic nervous system of the stomach is usually described as consisting of a nerve net lying between the muscle coats, and of groups of ganglion cells situated either under the serosa or between the muscle bundles. These cells are especially marked in the region of the cardia and in the pars pylorica; their existence in the former situation was first noted by Openchowski. E. Muller has supported the view that such a nerve net is present, and agrees with Dogiel that two types of ganglion cells may be identified; he considers one type to be vagal, the other sympathetic. Kuntz and Abel, on the other hand, believe, as did Gaskell, that the ganglion cells are all vagal in origin; the first-named denies the existence of a nerve net, stating that the myenteric plexus contains only free neurones. In the light of our present knowledge, however, it is impossible to draw very definite conclusions regarding the constitution of the myenteric plexus.

PHYSIOLOGY OF THE NERVES.

The study of the function of these nerves has offered a wide and complicated field for investigation. Certain facts are now well known, largely owing to the work of Langley, Cannon, Elliott, Carlson, and Wheelon and Thomas.

Vagus.—The conclusions reached by the majority of investigators, from the results of electrical stimulation of the nerves, is that the vagus

possesses both augmentor and inhibitor actions, but that it is mainly augmentor and accelerator as regards function; it has been emphasized by several workers, however, that the vagus is not a motor nerve in the ordinary sense.

An investigation carried out in association with McSwiney and Stopford showed that the effects obtained chiefly depend upon the pre-existing state of what may be termed the peripheral mechanism of the stomach; thus, the active digesting organ reacts more promptly, the resting one more sluggishly, to stimulation; moreover, in the former the response is primarily inhibitor, while in the latter it is augmentor. In all cases, however, an augmentor response follows stimulation sooner or later, even though the primary response be inhibitor. An inhibitor effect results in cessation of movement, if present, with or without dilatation; the latter effect depends on the presence or absence of an entogastric pressure at the time of stimulation. These results have been recorded by various methods and have been confirmed by direct observation. In addition the X rays have shown that an exaggeration of the normal type of movements occurs, and also that the stomach rapidly empties. It has been shown that 'tonus' changes are limited to the region of the body and fundus, and that the pyloric region takes no part in them (McCrea and McSwiney); Brown and McSwiney also have noted this, and Alvarez has found that a gradient of muscular rhythmicity may be described, most marked proximally, and decreasing as we progress distally towards the pylorus; this, however, Brown and McSwiney could not confirm when working on isolated muscle strips. These observations agree on the whole with the well-known fact that the stomach is functionally divisible into a proximal reservoir and a distal motor mill. Our results show that the vagi regulate both 'tonus' and movement, and, moreover, that these may be independent of one another. Courtade and Guyon, and Carlson, Boyd, and Pearcy have also noted that the effects obtained on stimulation depend on the existing condition of 'tonus'.

Sympathetic.—The splanchnic nerves have been described as having both an augmentor and inhibitor action on the stomach; the chief result of stimulation being inhibition; contraction is said to be more easily obtained at the pylorus than elsewhere. A distinction has been drawn between the type of response obtained on vagal and on splanchnic stimulation. Details are to be found in papers by Morat, Courtade and Guyon, Carlson, Boyd, and Pearcy, Klee, Wheelon and Thomas, and Carlson and Litt. Carlson suggests that 'tonus' is again responsible for the varying results, hypertonus favouring inhibition and hypotonus contraction. The results of some preliminary experiments carried out with McSwiney show that the type of response is quite dissimilar to that obtained with the vagus; the movements produced occur in the fundus and upper body, and are of the nature of a contraction or relaxation of this region as a whole. The work gives no indication thus far of any antagonism between vagus and splanchnic, save that movement in the active stomach may be inhibited by stimulation of the splanchnics. It would appear that the splanchnics regulate the 'postural tonus' of the stomach, having an augmentor action on the inactive, an inhibitor on the active, stomach.

That the nerves of the stomach contain both excito-secretory and depresso-secretory fibres has been long known from the work of Pavlov and his school, and more recently from that of Suda.

Central Influence.—The influence of the central mechanism on the control of the stomach has not been so fully investigated, but again both augmentor and inhibitor effects may be obtained by stimulation of the central cut end of one vagus, provided the other be intact (Morat, Meltzer and Auer, and Carlson, Boyd, and Pearcy). The fact that sensory stimulation influences the movements of the stomach is well known; Hughson has recently found, contrary to the usual statement, that emotion hastens the emptying of the stomach. Klee has investigated the vomiting reflex by way of the vagi, and Kronecker and Meltzer have described the receptive relaxation of the cardia on deglutition.

Cannon's theory of the acid control of the pylorus is no longer fully accepted. The functioning of the pyloric sphincter has been especially studied by Wheelon and Thomas, Carlson and Litt, and Alvarez, whilst McCrea and McSwiney have shown that the pyloric region is controlled by the pyloric vagal branch in a manner similar to that in which the remainder of the organ is controlled, but that 'tonus' changes do not occur. The influence of the nerves on the cardia and lower œsophagus appears to run parallel to that on the organ in general.

EXPERIMENTAL RESECTION OF NERVES.

The literature on the experimental resection of the extrinsic nerves of the stomach is extensive. The animals most frequently used have been the rabbit, cat, and dog. The site of division varies from the cervical region to the point of entry of the nerves into the stomach wall. Resection of both vagi in the neck has proved fatal, since œsophageal and laryngeal paralysis results, and death follows from respiratory infection; the right nerve may, however, be divided below the origin of its recurrent branch, the animal then usually surviving. Cannon has employed this technique. As we progress distally, the nerves may be resected about the lower part of the œsophagus where they form the œsophageal plexus; Carlson and Watanabe have in dogs employed a transpleural route to reach them here. Another site of division is on the pars abdominalis of the œsophagus; this locality has often been chosen in animals, and Exner has selected it in operations on man. Finally the terminal branches, both vagal and sympathetic, may be severed immediately before they enter the stomach wall. Latarjet has described and performed this operation in man (*see Fig.* 419); he draws attention to three groups of nerves which must be secured: (1) At the cardia; (2) In the right margin of the lesser omentum; and (3) Along the greater curvature, accompanying the right gastro-epiploic artery. He exposes the posterior nerves through an opening in the transverse mesocolon. Bircher has in man divided the vagal branches, three or four in number, high up on the lesser curvature. Stierlin, also in man, has 'circumcised' the stomach in order to entrap all nerves, his incision extending down to the mucous membrane A somewhat similar operation, though for a different purpose, has been described by Clare.

The splanchnic nerves have been resected intrathoracically in dogs by Watanabe, and Jean has described a technique for this operation in man: they may also be severed immediately after they have passed posterior to the crura of the diaphragm. The latter is the usual site in animals, and here they may be reached either by a transperitoneal or lumbar route. Recently Schiassi has described a procedure designed to divide the pyloroduodenal nerves. The right portion of the lesser omentum is divided in order to secure the sympathetic nerves which descend from above, and the body of the stomach is encircled by an incision which extends through the muscular coat and which severs the parasympathetic fibres. He has carried out this operation on man.

It is obvious that in all these operations, with the exception of those of Latarjet, Bircher, Stierlin, and Schiassi, fibres destined for other organs as well as those for the stomach and duodenum must necessarily be divided.

Other procedures, which have been carried out in man to intercept the path of the gastric nerves, and to which it is unnecessary to refer in any detail, include: operations on the jugular ganglion of the vagus (Kuttner); division of the posterior nerve roots (Foerster); ganglionectomy (Sicard and Desmarets), and extirpation of the cœliac ganglia or plexus (Jaboulay).

Results of Nerve Section.—The immediate results of nerve section have been carefully noted by several workers (Klee), but are of but little value from the surgical point of view. They cannot be clearly distinguished from the effects of shock and anæsthesia, and are in part due to nerve irritation. The more remote effects are of greater interest and importance, and in order to present them more clearly *Tables I*, *II*, and *III* have been prepared to

Table I.—Results of Nerve Section: Vagotomy.

Author	Dilatation	Tonus	Contractions		Emptying Time	
			Height or Depth	Interval Between	Initial	Total
Cannon	Within a few days almost normal				Delayed	
Carlson	—	Hypotonus	May appear increased	Increased	—	—
Nieden	Possibly +	A possible hypotonus	No change	No change	A possible slight delay	
Koennecke	+	—	Decreased	Increased	Delayed	Delayed
Watanabe	+	Hypotonus	Decreased	Irregular	Early slight delay	Delayed
Stierlin	+	Hypotonus	Decreased	—	Slight delay	
Litthauer	+ in 9 of 22 cases	Atony in 9 of 22 cases	Diminished motor activity		No change	Delayed
Lichtenbelt	—	—	Increased	—	—	—

Table II.—Results of Nerve Section: Splanchnotomy.

Author	Dilatation	Tonus	Contractions		Emptying Time	
			Height or Depth	Interval Between	Initial	Total
Cannon	Nil	Nil	Normal	Normal	Very little change	
Carlson	—	Hypertonus	—	Decreased	—	—
Koennecke	—	Hypertonus	Increased	Decreased	Hastened	
Nieden	Nil	No change	No change	No change	No delay	
Watanabe	Slight +	Early hyper-, late hypotonus	Slight increase	—	Almost normal	Hastened
Stierlin	—	Hypertonus	Good		Hastened	
Litthauer	—	—	—	—	No change	Hastened

Table III.—Results of Nerve Section: Denervation.

Author	Dilatation	Tonus	Contractions		Emptying Time	
			Height or Depth	Interval Between	Initial	Total
Cannon	Very small stomach	Hypertonus	No change	No change	Slight delay	
Carlson	—	Hypotonus	Increased	Increased	—	—
Nieden	Slight	—	—	—	Slight delay	
Latarjet	+	Hypotonus	Decreased	Increased	Delayed	
Watanabe	+	Hypotonus	Decreased	Increased	Delayed	Delayed

show the results obtained by the chief workers. *Table IV* indicates the methods used.

If we examine these, we find that on certain points complete accord does not exist. However, from the literature to which I have had access the following deductions may be drawn: (1) That section of one vagus or one splanchnic is without effect; (2) That vagal section results in dilatation, diminution of tonus, slow and weakened peristalsis, and delayed emptying—in fact, retardation of function; (3) That splanchnic section has almost exactly the reverse effects, and results in an acceleration of function; (4) That sections of all nerves gives similar but slightly less marked effects than vagal section alone. Several observers have stated that these results are not permanent, but that after a period varying from weeks to months, tonus is regained and movements appear normal. Both Watanabe and Koennecke

Table IV.—METHODS EMPL

Author	Animal	Number	Operations		
			Vagotomy	Splanchnotomy	Both
Cannon	Cat	—	Cervical, below right recurrent branch	Transperitoneal	Combin
Carlson	Dog	12	Intrathoracic	Transperitoneal	Combin
Latarjet	Dog	—	Denervation		
Koennecke	Dog Cat	8 5	Abdominal	Transperitoneal	—
Watanabe	Dog	20	Intrathoracic	Intrathoracic with division of sympathetic trunk	Combi
Lichtenbelt	Rabbit Cat Dog	—	Abdominal	—	—
Stierlin	Dog	9	Abdominal	(Extirpation of cœliac plexus)	—
Litthauer	Dog	22	Cervical Intrathoracic Abdominal	Intrathoracic	—

* Nieden

found that if extirpation of the cœliac plexus was substituted for splanchnotomy, the results were more marked and compensation was less complete.

Whether nerve section has any real influence either on secretion or acidity is doubtful. Psychic and reflex secretion disappear on vagal section and therefore the secretory curve is altered. This has been shown by Litthauer, and he also finds that secretion then becomes continuous even in the fasting animal. It appears to be certain that an active juice is still secreted after denervation. The work of Ivy and Whitlow suggests that the second or chemical phase of secretion is dependent on the integrity of the nerves of the pars pylorica; and that this phase is abolished by removal of the antrum, as in partial gastrectomy, has been demonstrated by Dagaew, Lewisohn, and Smidt.

It is necessary to mention some interesting observations made by Ivy on dogs. He produced duodenal ulcers by experimental means, in two series of animals, all of which had been provided with a small stomach, somewhat after the method of Pavlov. The first series possessed a normal nerve-supply to the stomach, but in the second series he carried out resection of both vagi and splanchnics together with extirpation of the cœliac plexus. It was found that the presence of an ulcer in the latter series produced less marked alterations in motility and rate of emptying than when the nerves were intact.

NERVE SECTION.*

Method of Examination	Period Observed		Notes
	Vagotomy	Splanchnotomy	
ys; animal tied down	2 weeks to 1 month. +	1 month. +	—
ons per œsophagus or by manent gastric fistula	2 weeks to 3 months	2 months	Hunger contractions only studied
X rays	—	—	Results permanent
ys, before and after opera-	11 months	3 to 4½ months	Division verified post mortem
ys and permanent duo- al fistula	14 days	1 month	Effects diminished in time; compensation
and Pavlov stomach	—	—	
X rays	(Some weeks to months)		Post-mortems carried out
manent duodenal fistula	(3 weeks at least)		All cervical cases died

* Nieden … of technique

Chronic ulcer formation is a common complication of vagal resection in the rabbit (van Izeren, Ophuls, Greggio, Zironi, 64 per cent). The stomach of this animal, however, functions as a paunch and is never completely empty, whilst experiments with drugs on surviving strips of its musculature give results different from those obtained in the cat and dog (Smith, and Brown and McSwiney). It is not thus comparable to the human stomach, as are those of the cat and dog. In the latter animals gastric ulcer following resection of the vagi is a rarity, according to the majority of investigators; Donati obtained negative results with dogs, Greggio found ulcers in a small percentage of his dogs, and Koennecke in one dog of his series, whilst ulcers are not recorded in the case of the cat. Lichtenbelt, on the other hand, obtained gastric ulcer in 70 per cent of his dogs; he states that for their causation all nerve twigs must be severed, and that they may be prevented if only a fluid diet is given and the stomach washed out daily. Splanchnic section is said to produce acute ulcers and erosions of the stomach and duodenum, but these lesions heal rapidly (Durante, Ivy). Stierlin could not obtain such lesions.

Recovery after these operations and maintenance of good health is the rule if the after-treatment is carried out with reasonable care. Very few out of the many workers have found any difficulty in keeping their animals alive and in good condition. Donati examined the urine of his rabbits after

vagotomy, but found it normal. After extirpation of the cœliac plexus Aldehoff and v. Mering have noted a temporary diarrhœa, and temporary glycosuria, but never the presence of acetone or albumin.

The effects of stimulation of either the vagi or the splanchnic nerves on the small intestine appear to be similar to those obtained with the stomach (Klee); Koennecke, however, finds that vagal resection has little effect on the intestine.

THE AUTHOR'S EXPERIMENTS.

The results of a series of experiments which have been carried out with McSwiney and Stopford appear in brief form in *Table V*. The vagi were

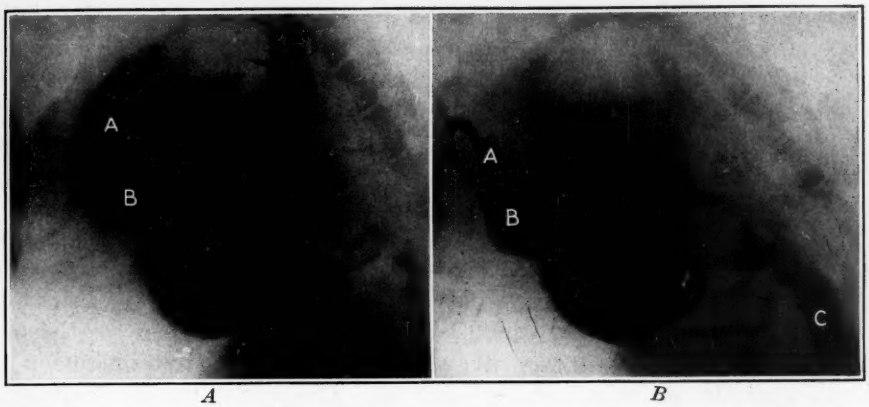
Table V.—Experimental Nerve Section: Author's Results.

Operation and Number	Dilatation	Contractions		Emptying Time	
		Depth	Interval Between	Initial	Total
Vagotomy (17)	None detected	Increased	Decreased or no change observed	Marked decrease	Slight decrease or within normal limits
Splanchnotomy (4)	None	Increased	No change detected	Marked decrease	Decrease
Vagotomy and splanchnotomy (4)	None detected	Increased	No change detected	Marked decrease	Within normal limits
Unilateral vagotomy (11)	No variations from within the normal limits detected				

divided on the pars abdominalis of the œsophagus, and the splanchnics immediately below the crura of the diaphragm, where they were reached by the abdominal route. Partial resections have in addition been carried out, the hepatic branch of the vagus has alone been divided, vagotomy exclusive of this nerve has been performed, and complete denervation of the pylorus has also been effected. When one vagus was to be severed, this operation was performed in the cervical region. The results were noted by means of repeated X-ray examinations, carried out at intervals after operation, and compared with similar examinations made before operation. Observations have been made over periods ranging up to nine months with double vagotomy, seven months with double splanchnotomy, eight months with denervation, and twenty-two months with unilateral vagotomy. To summarize these findings:—

1. The results of vagotomy or complete denervation, which are almost identical, may each be divided into two groups—those which are temporary or which are compensated for in time, and those which may be considered permanent. The first group comprises paresis and dilatation; the second includes increased depth of peristalsis, possibly only apparent, some slight dilatation, and a marked decrease in the initial, with a slight decrease in the

total, emptying times. The early initial emptying is the most prominent feature of these, the food appearing to pour into the duodenum, perhaps



A B

FIG. 417.—Dog 5. Double vagotomy. Plates taken eight months after operation.

A: Five minutes after barium meal, food leaving stomach. A, Duodenal cap; B, Pyloric antrum.

B: Ten minutes after meal. A, Duodenal cap; B, Pyloric antrum; C, Cæcum. Before operation no food left the stomach within twenty-five minutes after feeding. Total emptying time reduced by approximately one hour. Peristalsis appears normal.

unassociated, at least at first, with peristalsis. This appears to be due to a semipatulous condition of the pyloric sphincter. In a few instances a terminal delay was noted after a very rapid preliminary emptying. (*Fig.* 417.)

2. Splanchnotomy results in increased depth of peristalsis, and the stomach appears small and tubular in form. These effects, again, gradually become less marked, and the organ returns towards the normal state. In this instance also the initial emptying time remains markedly shortened, while there is an appreciable decrease in the total emptying time. The rapid emptying seems to depend rather on increased activity than on a patulous condition of the sphincter. (*Fig.* 418.)

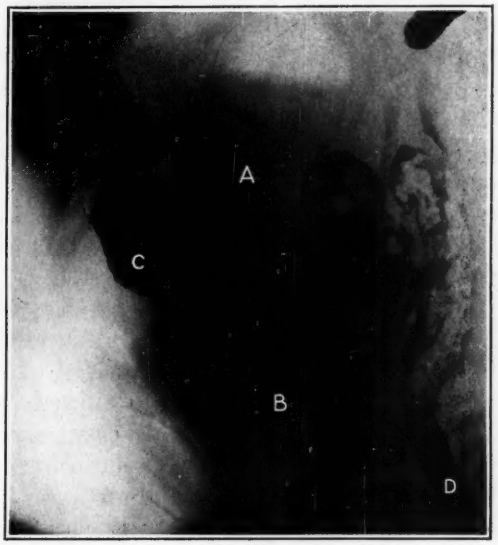


FIG. 418.—Dog 8. Double splanchnotomy. Five months after operation. Plate taken five hours after a barium meal, showing acceleration of gastric and intestinal function; a considerable portion of the meal is in the large gut. A, Stomach; B, Small gut; C, Large gut; D, Rectum. Before operation the total emptying time was invariably more than seven hours.

3. Denervation of the pylorus or resection of the vagal branch to the pylorus gives similar results to vagotomy or complete denervation of the stomach, but the early paresis and dilatation do not appear.

4. The effects of resection of the nerves on the function of the small intestine are similar to, but less marked than, those occurring in the stomach.

It is obvious that our findings in vagotomy and denervation, and the conclusions drawn from the literature, differ most markedly on the question of emptying times. The results of splanchnotomy are similar to those previously recorded. Every precaution was taken in this series to prevent the possibility of psychic inhibition before operation, to establish the normal variations in the individuals examined, to employ only the X rays without other procedure in noting the results, and to confirm the operations post mortem.

The pylorospasm and cardiospasm which have been described as immediate on vagal section (Klee, Exner) are purely temporary, and are no doubt due to the irritation of the nerve section. The permanent delay in emptying time which has also been noted may be attributed to the escape of the pyloric nerves at operation, which can occur either in the Latarjet operation or in subdiaphragmatic resection of the nerves. The early gastric paresis then contributes to the retention, and is probably aided by reflex irritation of the remaining fibres. This explanation undoubtedly fitted the facts in the case of one dog of this series in which an incomplete Latarjet operation was carried out. It must be recalled, however, that in a few instances a terminal delay was observed; this occurred in the dog only, and followed complete denervation. The control of the emptying time by X-ray examination is more reliable than by means of a duodenal fistula which several workers have employed. Furthermore, it would appear that insufficient attention has been paid to the individual variations of the normal, and in many instances the time of observation has been too short, not allowing repeated examinations at sufficient intervals. Hughson's observations on dogs, that any abdominal operation—even a simple laparotomy—delays the emptying of the stomach, is of importance.

Ulcer formation has been observed in this series in approximately 50 per cent of rabbits after vagotomy, but not in cats or dogs. Following splanchnotomy, multiple duodenal erosions have been found in one cat only. No histological changes were observed in any of the abdominal organs examined post mortem, and the urines of the dogs examined qualitatively after operation were normal; the animals maintained their weight satisfactorily. Recovery is rapid, but some care, especially as regards feeding, is necessary for the first week or ten days. A temporary constipation after resection of the vagi, and a temporary diarrhœa after division of the splanchnics, is often observed. In general, after these nerve resections the great majority of the animals appeared to live normal lives, and no mortality that was attributable to the nerve sections occurred, if rabbits are excepted.

Brown has examined the musculature of the stomach of a few of the operated animals. His results up to the present show that after vagotomy the rate of contraction of the pyloric sphincter is slowed, while that of the body is increased. After section of both splanchnic nerves the rhythm of the pyloric sphincter is increased, but there is no change, beyond the limits of the normal, in the remainder of the stomach. Complete denervation results in a slightly lowered rhythm of the pyloric sphincter, while that of the antrum and body

is somewhat increased. His findings therefore run parallel to those observed with the X rays.

Conclusions in Regard to the Physiology of the Nerves.—The general conclusions which may be drawn with regard to the functions of the extrinsic nerves of the stomach, both from the literature and from the work with which I have been associated, are as follows :—-

The vagi and the sympathetic nerves may each act either as augmentors or inhibitors of the stomach. The vagus may be described as predominantly augmentor. It is not suggested that one is definitely antagonistic to the other; this is not the case; they belong to different systems, or rather to different parts of the same system, and govern different functions. The sympathetic is concerned chiefly with the 'postural tonus' of the organ, the vagus both with this and with the motor function. Each nerve is undoubtedly both efferent and afferent, transmitting centrifugal and centripetal impulses, and concerned with the motor, vasomotor, secretory, and sensory functions of the organ. They act as regulators of the stomach, and normally guide it to function in harmony with other parts of the body by means of the reflexes passing through them. One vagus or one splanchnic may be divided without influencing the organ in any way; the remaining colleague of either then suffices to carry on the work of both. It would appear that both vagi and splanchnics are together necessary for the normal regulation of the stomach, for when both vagi are severed effects appear which are due either to the abolition of vagal impulses, with an associated exaggeration of splanchnic action, or to one of these alone; such results, however, are temporary, and gradually diminish. If both splanchnics are divided, comparable effects occur, presumably of similar origin; there is, however, a more definite suggestion of vagus over-action in this case than of splanchnic over-action in the preceding instance, and it is also evident for a longer period. The cutting out of one system of regulators therefore gradually results in a diminution and in almost a disappearance of control by the remaining system, the final result approaching but not attaining the effects of section of both. In this complete denervation, the intrinsic automatic mechanism takes on the proper functioning of the stomach no longer guided by external reflexes.

As regards secretion after nerve section, two facts only are definitely stated: (1) On section of the vagi 'psychic secretion' is lost; and (2) An active gastric juice is still secreted. It is probable that division of the nerves of the pyloric antrum abolishes the chemical or second phase of secretion. Further work on the question of secretory changes following nerve resection is necessary, and it is possible that certain of the motor effects obtained are in part dependent on changes in acidity and secretion brought about by the denervation.

THE NERVES IN RELATION TO DISEASE.

Chronic Gastric Ulcer.—The part played by the nerves in the study of disease of the stomach is of considerable interest and importance. The neurogenic theory of causation of chronic gastric ulcer must first be referred to. This theory is attributed to Rössle, and is supported by many authors, including von Bergmann; Gruber states that it is held "that through a

primary, even though morphologically or at least macroscopically unrecognizable, injury in a root region of the vagus, or through an anomaly of the nerve regions included in the reflex arcs, a quite remote, severe circulatory disturbance leading to tissue necrosis—e.g., in the gastric and duodenal wall—may be produced". Whilst not entirely subscribing to this view as supplying the explanation of the cause of all chronic ulcers, we must admit that a certain proportion may thus be produced; and it would appear that a lesion of the gastric or duodenal wall, the result of infection or injury, is more likely to become chronic if an irritation of the nerves is set up. In this relation it is of interest to note that all chronic gastric ulcers are situated in the region of the lesser curvature, the so-called 'ulcer-bearing' area, and that this site corresponds to the area through which the nerves enter the stomach wall. Askanazy and also Dible have found that quite prominent nerves are often to be seen in the floor of an ulcer and in the surrounding fibrosis, and in addition that ganglion cells of the myenteric plexus may be found. This nerve irritation results in local spasm and ischæmia, and thus prepares a suitable soil for autodigestion. There is no doubt, moreover, that distant reflex disturbances and spasm may be set up by such irritation, and several observers have shown that these occur with ulcer (Klee, Borchers, Stierlin, Loeper and Forestier, Saloz and Moppert, and Held and Roemer). From the anatomy of the nerves it is easy to explain thus the occurrence of pylorospasm in ulcer of the lesser curvature, and of gastrospasm in duodenal ulcer, both of which are common radiological findings. Woodburn Morison* states that ulcer of the lesser curvature usually retards emptying, and that in pyloric ulcer retardation is the rule, whilst in duodenal ulcer acceleration is the common occurrence, often, however, associated with a terminal delay. He finds that in the 'nervous dyspepsias' any of these findings may be mimicked, and in this he differs from Saloz and Gilbert, who find but little variation from the normal in these patients. In the case of pyloric ulcer the site and local irritation serve to explain the retention, and in other situations any alteration may be explained by a reference to the nerves, whether they are involved or not, and whether, if involved, the lesions are irritative or destructive. Askanazy has classified the changes undergone by the nerves in the base of an ulcer into (1) destructive, (2) passive, which include peri- and endoneuritis, and (3) productive, the last including neuroma formation. Reflex spasms—the result of ulcer—especially pylorospasm, cause retention; retention and infection favour the further development of an ulcer, and so a vicious circle is set up. Alternatively it is clear that reflex pylorospasm, however caused, results in retention and hyperchlorhydria (Bolton), thus paving the way for the development of ulcer.

Lim, Ivy, and McCarthy assert that gastric secretion is in part due to mechanical stimulation, i.e., to distention; they believe that this explains to some extent the 'hypernormal gastric secretion' in cases of pyloric obstruction. Pylorospasm has therefore a dual effect on secretion and acidity, in that, first, increased secretion is promoted, and, secondly, the normal neutralization by reflux through the pylorus is prevented. It would thus

* Personal communication.

appear that a lesion in any part of the course of the nerve paths is a factor in the development of gastric ulcer. The lesion may be primary and situated at a distance from the stomach, thus fulfilling the conditions of the 'neurogenic theory', or may be secondary and either intra- or extra-gastric, the result of inflammation or injury of the stomach wall or of a more remote part such as the appendix.

It has been shown that if the pyloric antrum is completely removed, as in partial gastrectomy, there occurs a loss of the chemical or second phase of gastric secretion, achlorhydria frequently resulting (Dagaew, Lewisohn, Smidt). Berg therefore recommends such a procedure in all cases of ulcer, for with regard to acidity the results of gastrojejunostomy vary, and it is an accepted fact that chronic gastric ulcer can only occur in the presence of hydrochloric acid (Mann and Williamson); he has observed that a simple pylorectomy does not produce this result. The work of Ivy and Whitlow suggests that the nerves of the pars pylorica play a great part in this second phase of secretion, and that their section abolishes it. Their work has failed to confirm that of Edkins and Tweedy, who described 'gastric secretin' or 'gastrin'.

The radiological findings which have been made in certain cases of hour-glass stomach are of interest. In a few instances the proximal pouch empties freely and rapidly, yet delay occurs in the distal pouch because of pylorospasm. Woodburn Morison* finds that such pylorospasm is frequent in patients with hour-glass stomach. It is without doubt reflex in origin, and again explained by the distribution of the nerves, if we except those instances, not very infrequent, in which a second lesion causing local spasm is present near the pylorus. The type in which a rapidly emptying proximal pouch is associated with pylorospasm affords an explanation of the good results which have been recorded in a few cases when gastrojejunostomy to the distal pouch has been performed.

'Nervous Dyspepsias'.—The conditions known by the title of the 'gastric neuroses' or 'nervous dyspepsias' must now be considered. They may be divided into two broad classes, the vagotonic and the sympatheticotonic of Eppinger and Hess; the first or vagotonic group show signs and symptoms indicative of increased vagal action, the second of increased sympathetic action. Excessive vagal control is evidenced by hypermotility, either with or without 'hypertonus', as shown by spasm; increased sympathetic control results in atony and 'hypotonus'. The increase in vagal action may be real or apparent; in the latter instance there is lack of sympathetic control, and the resultant unbalanced action appears in the form of excessive vagal influence; similarly increased sympathetic action may also be real or apparent. Many authors believe that the sympathetic plays a greater part than the vagus in these disorders, and Renard has described a definite " syndrome sympathique général ".

These conditions have at present no known pathology, but are recognized and described from their signs and symptoms. In none have any lesions been demonstrated either in the stomach or its nerves; there is, however,

* Personal communication.

one disease in which, when gastric symptoms of hypermotility and spasm occur, lesions may be found in the vagus and in the posterior nerve-roots and ganglia—I refer to the gastric crises of tabes dorsalis. Furthermore, that the nerves of the stomach are not immune to pathological changes is obvious from various case reports (Longet, Massary and Walser).

Eppinger and Hess believe that unbalanced action of the nerves may be constitutional in origin, and they discuss the possibility of endocrine instability as a cause, calling attention to the findings in Addison's disease and lymphatism; furthermore, they have shown that vagotonia may be generalized or local. Hernando also emphasizes the action of the endocrine organs upon the stomach, both directly through their hormones and by the action of these on the autonomic system. Latarjet believes that the source of the disturbance may be either central or peripheral, and classifies his cases into psychopathies and gastropathies. In Ryle's classification of the dyspepsias these cases are included in *Groups II* and *IV*, the former being the nervous or psychogenic and the latter the irritative; he divides the symptom complexes into pressor and depressor, which appear to correspond in general to the vagotonic and sympatheticotonic. Gastrospasm, including cardiospasm and pylorospasm, has been studied from the clinical and radiological aspects by Held and Roemer.

Amongst the symptom complexes are some which have received generally accepted titles, because the clinical findings in them are definite and constant; such are hyperkinesis or supermotility, atony, incontinence of the pylorus, insufficiency of the cardia, and with these must be included cardiospasm (idiopathic dilatation of the œsophagus) and pylorospasm. Whether the so-called hypertrophic pyloric stenosis of infants should be added to these is not definite. I am not aware that this condition has as yet been satisfactorily distinguished from pylorospasm. A contracted, tubular condition of the pars pylorica is not uncommon at post-mortems on infants, but is rare in adults; this would seem to point to an increased irritability of the nerves of the infant. Should either a lowered threshold to stimuli or an increased excitability of the nerves be present, motor disturbances would be expected to be of frequent occurrence, and, in the instance of pylorospasm, an explanation would be supplied. It is possible that pylorospasm and hypertrophic pyloric stenosis of infants may be but degrees of the one condition; Cameron tends towards this view, and in a recent review of the findings in congenital pyloric stenosis notes that the obstruction is invariably intermittent and that no true stenosis exists.

The theories advanced to explain congenital hypertrophic stenosis may be applied with equal force to all forms of sphincteric obstruction in which no organic causes are found. There seems no sound reason why the presence or absence of muscular hypertrophy should be selected as a definite line of cleavage marking off 'stenosis' and 'spasm' into distinct entities; it is quite conceivable that spasm may result in hypertrophy (see also Held and Roemer). Theories which have found most favour in the explanation of these conditions are those of spasm, muscular inco-ordination, and achalasia, and it may be presumed that in any given instance of spasm or paralysis the cause of either is extrinsic or intrinsic in origin. An intrinsic source is best illustrated by

the presence of some local, demonstrable lesion; an extrinsic, which acts through the nerves, has been shown above to be equally efficacious, and Cameron suggests, when referring to such conditions in infants, that they may be due to an unequal development of the nervous augmentor and inhibitor apparatus. In the absence of a demonstrable intrinsic lesion it is necessary to seek for an extrinsic source. An extensive literature on "spastic tumour of the pyloric canal" will be found in a paper by Lerche.

Secretory and sensory gastric neuroses are part and parcel of the conditions referred to above; in them these symptoms predominate, but there are always associated motor disturbances; hyperchlorhydria may be instanced as an example. A careful review of the functional achylias has been made by Udaondo.

The accompanying brief case-notes illustrate the two chief types of the 'nervous dyspepsias'.

Case 1.—**Vagotonic or pressor type.**

A. B., age 45. Male. Intermittent attacks of indigestion extending over a period of three years.

X-ray examination showed stomach lying somewhat low, no filling defect, pylorus patent, duodenal cap well formed, peristalsis active, emptying with great rapidity but a final delay.

OPERATION.—No sign of gastric or duodenal ulcer. Appendix removed.

Two and a half years later no improvement in general condition. Still suffers from indigestion.

Case 2.—**Sympatheticotonic or depressor type.**

M. N., age 52. Male. History of twenty years' indigestion.

Bismuth meal showed a large atonic type of stomach. Pylorus opposite 3rd lumbar vertebra. Five-hour bismuth meal: Delay in emptying.

Clinically: Atonic dyspepsia.

Radiographically: Atonic stomach with no evidence of gastric or duodenal ulcer.

OPERATION.—No ulcer; no growth.

We may conclude that disorders of the gastric function can be produced either by hypo- or hyperfunction of the extrinsic nerves. The primary cause which gives rise to such disordered function may be located: (1) Peripherally; (2) In the nerve paths; (3) Centrally.

1. Irritation, the result of inflammation, is no doubt the most common peripherally situated cause. The irritation may have its origin at a distance, e.g., the appendix or gall-bladder, and thus produce a reflex dyspepsia which may be termed of remote origin, in contradistinction to that which lies in the wall of the stomach or duodenum and may be referred to as proximal. Pylorospasm, supermotility, and hyperchlorhydria are all easily explained on this basis; in addition, it must be noted that factors favourable to the development of ulcer may be thus brought into being; indeed, certain conditions may well be termed pre-ulcerous.

2. Lesions in the nerve paths are exemplified by the findings in the gastric crises of tabes dorsalis; lesions of the posterior nerve-roots which result in gastric disturbance are named 'gastro-radiculites' by Bouchut and Lamy.

3. Disorders of central origin may be constitutional, as suggested by Eppinger and Hess, and possibly a result of endocrine instability. It is very probable that the number of 'neuroses' will be materially reduced by the discovery of lesions and inflammations of the peripheral mechanism and nerve paths which research has not as yet demonstrated. The part which may be played by toxæmia and by drugs in their causation must not be lost sight of.

Irritation on the one hand, and diminished function on the other, with various combinations or stages of these, may thus account for a number of the 'nervous dyspepsias', of which even the differential diagnosis is now very incomplete.

It is stated that disorders of peristalsis may arise from extensive scarring, or be due to a local removal of the stomach wall, especially if from the region of the lesser curvature. Alvarez has raised this question, and suggests that a sleeve resection is preferable to a wedge; Berg also states that disturbances of motility follow the wedge resection; he believes that a tract of conducting tissue may pass down the lesser curvature and connect the nodal tissue described by Keith in the region of the cardia with another node near the incisura angularis. That a node may exist in this region is suggested to him by the observation that the movements of the cardiac and pyloric portions of the stomach are quite distinct and may occur separately (Berg and Crohn, McCrea, McSwiney, Morison, and Stopford, and McCrea and McSwiney). Cannon has shown that complete circular incisions of the tunica muscularis do not subsequently interfere with peristalsis. It is of interest to note in this connection that Stierlin ascribes better results to the sleeve resection because in this operation all the nerves must necessarily be divided.

THE NERVES IN RELATION TO SURGERY.

The nerves of the human stomach have received considerably more attention at the hands of the surgeon than is perhaps generally known. I believe that Jaboulay in 1899 was the first to advocate surgical interference with them, the operation he suggested being extirpation of the cœliac plexus. Mingazzini in the same year performed the first intradural division of the posterior nerve-roots for a case of gastric crises. I desire in particular to refer to the work of Exner, 1911, of Bircher, 1920, of Latarjet, 1921, and of Schiassi, 1925, and of those who have followed their techniques (*Fig.* 419).

Exner performed subdiaphragmatic resection of the vagus, and his cases were all tabetics with gastric crises. He considered that the vagus controlled vomiting, and that Foerster's operation was only of use in cutting off sensation via the splanchnics. He observed on section of the nerves an immediate dilatation, atony, and pylorospasm, and because of the last added to his procedure a gastrojejunostomy or a gastrostomy. *Table VI* is from Exner and Schwarzmann, 1914–15. I have added a case published by Thomsen.

Bircher's operation would appear to be an incomplete resection of the vagi. He has operated on 20 cases which clinically resembled gastric ulcer: one proved to be an ulcer, in 6 the diagnosis was doubtful even at operation, and in the remainder no ulcer was present. Before operation almost all these cases showed an atonic stomach. He states that the results were good;

vomiting, nausea, and belching were abolished, pain disappeared, and secretion and acidity were reduced, the latter very considerably. Subsequent X-ray examination showed an increase of tonus.

Latarjet's operation, to the technique of which I have referred, is equivalent to section of all the extrinsic nerves. The results in man, he finds,

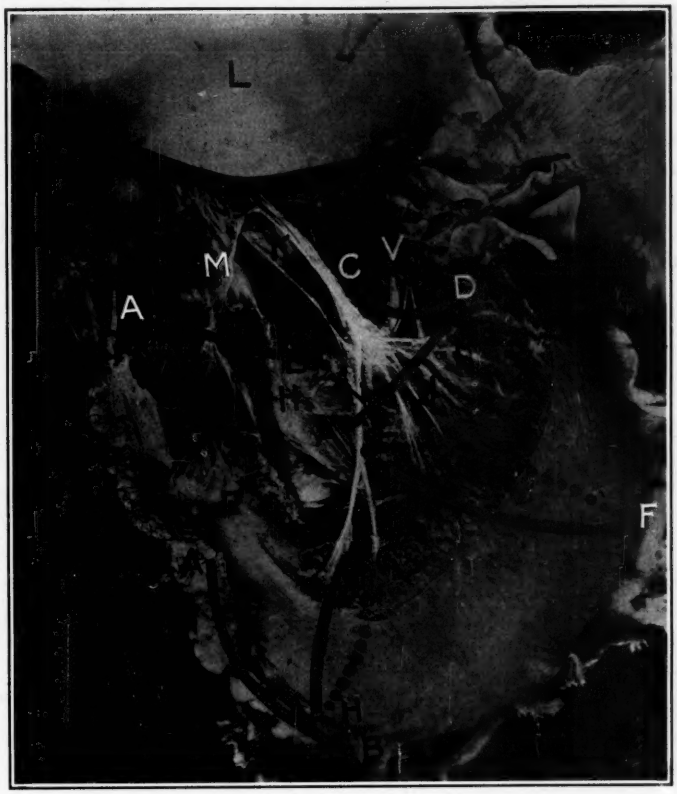


FIG. 419.—Photograph of a dissection of the nerves of the stomach on which are illustrated the sites of division of the nerves in the operations of Latarjet, Exner, Stierlin, and Schiassi. V, Anterior vagal trunk (two divisions); J, Gastric branches; K, Gastro-hepatic branches; L, Liver; M, Pyloric and duodenal nerves; N, Principal anterior nerve of the lesser curvature; A—B, The Latarjet operation (three steps; the fourth, in which the nerves on the posterior surface are reached, is not indicated); C—D, Exner's operation; E—F, Stierlin's operation; G—H, Schiassi's operation (two steps).

Table VI.—VAGOTOMY FOR GASTRIC CRISIS. (*Exner and Schwartzmann*, 1915.)

AUTHOR	NUMBER OF CASES	CURE	NO RESULT	OBSERVATION TOO SHORT	IMPROVED	WORSE	DEATHS
Exner ..	14	7	2	2	2	0	1
Ranzi ..	3	1	1	1	—	—	—
Kuttner ..	1	—	—	—	—	1	—
Hildebrand	1	1	—	—	—	—	—
Neumann ..	1	1	—	—	—	—	—
Total ..	20	10	3	3	2	1	1
Thomsen ..	1	1	—	—	—	—	—

are exactly similar to those described by him in dogs. His aim was to cut off sensation, diminish the frequency and intensity of the contractions, and probably to diminish acidity. I have found in all 59 cases operated on by Latarjet, Wertheimer, Pauchet, and Gianolla; the details are not fully given, but only in 18 was a simple denervation without other procedure carried out (*Table VII*). Their results over a comparatively short observation period are good. Considerable pain is said to follow the operation for the first twenty-four hours, but is easily controlled by morphia. Their cases include examples of gastric ulcer, of the gastric crises of tabes, and of certain of the stomach neuroses, which Latarjet classifies as gastropathies; he states that those most suitable for operation are the vagotonics who show pain, hypertonus, hypermotility, and vomiting, and in whom no ulcer is present. However, even the psychopathies are improved.

I have found no record of any case operated on by the technique described by Jean.

Table VII.—Denervation without other Procedure. (*Latarjet*, 1921–3.)

Gastropathy	Number of Cases	Result	Notes
Vagotonic	1	Disappearance of all all symptoms	A previous exploration and appendicectomy
Vago-sympathetic	2	Cure	Observation up to 18 months
Vago-sympathetic with ptosis	5	Cure	Observed 2 to 6 months. Operation by Pauchet in 2 of these
Vago-sympathetic with dilatation	1	Cure for 1 year, then slight recurrence	
Vago-sympathetic with hypotonus	1	Cure	Observed 2 months
Unclassified	4	Cure	Observation up to 1 year
Gastric crises	4	Very marked improvement in pain and vomiting	—

Steinthal operated on two cases of gastric ulcer by the method of Stierlin. The first showed atony, hypersecretion, and hyperacidity; after operation peristalsis was found to be normal, but the hypersecretion was uninfluenced. The second showed increased peristalsis, a six-hour residue, and hypersecretion; after operation increased peristalsis was still present, and secretion was further increased. He observes that the operation is almost impossible with an ulcer situated high up on the lesser curvature, and, on the whole, has formed an unfavourable opinion of the operation.

It is necessary to call attention to the fact that in any procedure involving resection of the lesser curvature the chief nerves are necessarily divided; and possibly certain rare sequelæ of such operations may be thus explained.

The surgical treatment of cardiospasm or idiopathic dilatation of the œsophagus is usually one of four procedures. These four are œsophago-gastrostomy, dilatation of the cardiac sphincter, œsophago-plication, and the stripping or freeing of the lower œsophagus. Dilatation is ordinarily digital, and is carried to the point of paralysis of the muscle (Walton), whilst in the other three operations a considerable denervation must be effected. Bull, in one of his œsophago-gastrostomy patients, divided the vagi, although as a rule he endeavours to avoid them; and Meyer in one case of œsophago-plication attributed the results obtained to the denervation effected, although this author later came to the conclusion that a certain proportion of his mortality in operated cases of carcinoma of the lower œsophagus was due to division of the vagi.

The operation designed by Schiassi to resect the pyloroduodenal nerves resembles in some respects that of Latarjet, in others that of Stierlin. It is probable that similar results would be obtained even if the 'circumcision' was omitted, since the section of the supraduodenal pedicle includes both para-sympathetic and sympathetic nerves to the pylorus and duodenum. He has performed the operation on 26 patients with duodenal ulcer, but in 15 of these he added a gastrojejunostomy; he is satisfied that the results improve upon those obtained by routine methods. The object of the nerve resection is to give rest to the pylorus and duodenum.

Koennecke in 1922 exhaustively reviewed the surgery of the nerves of the stomach; he concluded that such operations were not justifiable. His chief objection appeared to be that, although no ill effects followed these operations on animals, yet if performed in the presence of any pathological condition this might be aggravated, and he considered that such would be the case in man. This, however, would only occur if an inappropriate operation was performed or an unsuitable case chosen, and I consider that Exner's, Bircher's, and Latarjet's results sufficiently meet this objection.

Borchers in 1921 also decided against operations upon the vagus, his reason, so far as I interpret it, being that since the vagus is not truly a motor nerve, in the same sense as a nerve to skeletal muscle is, it is unwarrantable to divide it in order to influence reflex spasm and hypermotility. I hope that in the preceding pages this criticism has been disposed of, and, moreover, that it has been shown that these operations have a wider scope than set forth by him.

Laignel-Lavastine, in a recent review of the present state of the surgery of the sympathetic system, comments favourably on the future awaiting the operative surgery of the nerves of the stomach; while Eiselsberg notes that perhaps the more radical of the present procedures may be replaced by operations upon the sympathetic nervous system of the abdomen.

CONCLUSIONS.

A review of our knowledge of the anatomy and physiology of the nerves of the stomach has been given in the preceding pages, and an attempt has been made to correlate this knowledge with certain features of the pathology of the organ. The effects of resections of the nerves have been described in

animals, and certain observations made on man have been recorded. It is evident that in animals these operations do not interfere with the general health or with the intrinsic functioning of the stomach. The results obtained by those who have operated on man support this statement. It therefore appears a logical step to investigate further the application of such surgical procedures to man.

By resection of the nerves certain effects on the stomach have been produced at will, and these may be desirable in various morbid conditions. Complete denervation results in loss of all gastric sensation and thus of referred pain, and there is also a loss of reflex control and consequently of reflex spasm; temporary diminution of motility and an increased rate of emptying occur in addition, while secretion and acidity are in all probability reduced. Vagotomy gives very similar results, but some splanchnic control remains. Splanchnotomy, by increasing vagal action, raises 'tonus' and excites the motor function as a whole. Resection of the vagal pyloric branches, or complete denervation of the pylorus, produces a semipatulous condition of the pyloric sphincter, reflex spasm is abolished, and more rapid emptying obtained. In brief, pain, motility, spasm or atony, and emptying time may be controlled to a considerable extent. The value of such changes in gastric function and sensation becomes apparent when certain morbid conditions are studied.

In considering the application of such operations, it is necessary to note that it has been shown that the nerves play a part in the development of the chronicity and complications of ulcer, if not in their actual causation. Denervation should therefore, if these premisses are correct, prove a factor in the promotion of healing and in the prevention of recurrence. A further use of these operations lies in their application for the relief of such symptom complexes as are found in the 'gastric neuroses'. If section of the nerves of the pyloric region abolishes the second phase of gastric secretion, as is believed by Lim, Ivy, and McCarthy, then denervation is definitely indicated in cases of 'hyperchlorhydria', more especially as 'hyperchlorhydria' is regarded as a precursor of gastric and duodenal ulcer. They should also be of value as supplementary procedures to a palliative gastrojejunostomy for carcinoma. The intestine can also be influenced by such nerve resections, and in the future their application may be extended to embrace derangements of the intestinal function.

Four of these operations, those of Exner, Bircher, Latarjet, and Schiassi, have already been applied to man with promising results, and their extension demands further trial. Clinical observation and the careful selection of cases should demonstrate the appropriate modification for each type of patient.

The Latarjet operation is no doubt the operation of choice when complete denervation is desired. The nerve-supply of other organs is not interfered with, and the stomach will continue to function automatically, ignoring, and ignored by, other parts. Therefore an organ, the control of which has deviated too far in either direction, will be restored to a basic condition by this operation. Resection of the vagi or splanchnics alone must be approached with more care; nevertheless, these operations may prove of great value. Subdiaphragmatic vagotomy is the simplest of those designed

to abolish vagus over-action, whilst transpleural splanchnotomy for diminished vagal control or increased sympathetic action, following the technique of Jean, is more feasible in man than any transperitoneal route.

The prophylaxis of ulcer and the cure of various of the 'gastric neuroses' are the two chief uses of these procedures; with the former they will be associated with an operation such as local excision of the ulcer. I would suggest that denervation of the pylorus, or resection of the hepatic branch of the vagus as it crosses between the layers of the gastrohepatic omentum, may, in certain instances, replace either of the operations noted above, especially for the relief of pylorospasm. It is further suggested that it is worthy of trial in the hypertrophic pyloric stenosis of infants. The operation of

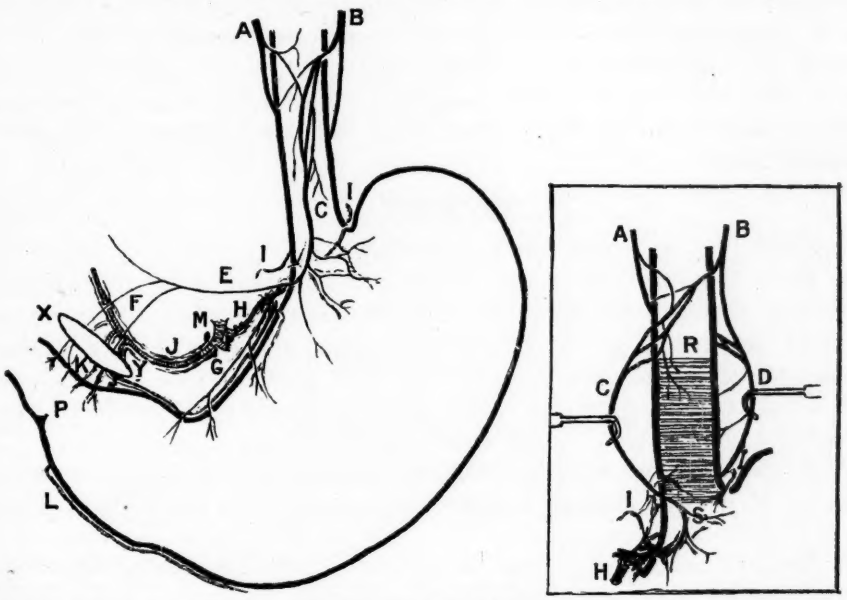


FIG. 420.—Drawing to illustrate the nerve-supply of the stomach. The site of division of the nerves in the operation of denervation of the pylorus is shown (X—Y). The inset shows the area stripped in denervation of the lower œsophagus (R—S). A, Right vagus; B, Left vagus; C, Anterior vagal trunk: D, Posterior vagal trunk; E, Hepatic vagal branch; F, Pyloric and duodenal branches; G, Principal anterior nerve of the lesser curvature; H, Sympathetic nerves with the left gastric artery. I, Sympathetic fibres with the inferior phrenic arteries; J, Sympathetic nerves with the hepatic artery; K, Pyloric sympathetic branches; L, Sympathetic fibres with the right gastro-epiploic artery; P is placed on the pylorus, and M indicates the cœliac artery.

denervation consists in the division of the anterior layer of the hepatoduodenal ligament and adjoining part of the anterior layer of the gastrohepatic omentum immediately above and parallel to the pylorus. The superior aspect of the pylorus and first stage of the duodenum are then cleared by a process of gauze and scissor dissection, either with or without ligature of the right gastric artery, and the nerve-supply is thus effectively destroyed (*Fig.* 420). The operation is of the shortest and simplest, and it must, *a priori*, prevent reflex pylorospasm, and produces a semipatulous condition of the sphincter. The operation recently described by Schiassi for duodenal ulcer is very similar.

Another operation which is suggested as a logical procedure is denervation of the lower œsophagus. Its application lies in the condition known as cardiospasm. So long as denervation is confined to the lower third, no ill effects should ensue. The operation may be performed either by a transpleural or transperitoneal route; of these the latter appears preferable. The lower œsophagus is freed, drawn down, and whilst the vagal trunks are displaced laterally the œsophagus is stripped in order that all nerve twigs may be effectively destroyed. Accidental wounding of the vagal trunks, should it occur, has been shown not to be of such importance as was formerly believed. The œsophagus may also be exposed by the method described by Grégoire.

Definite organic stricture is the chief contra-indication to the performance of these operations if carried out alone; pyloric stenosis is, however, the condition in which gastrojejunostomy gives its most satisfactory results. Another more theoretical contra-indication is that after denervation a serious organic lesion, such as carcinoma, may silently develop. Latarjet has recorded a case.

SUMMARY.

Evidence has been put forward to show:—

1. That the anatomical distribution of the nerves to the stomach is sufficient to account for instances of reflex spasm or of incontinence of the pylorus in the case of gastric or duodenal ulcer, and of spasm or of atony of the body of the stomach with duodenal ulcer.

2. That the 'ulcer-bearing' area of the stomach corresponds to the area in which the nerve branches are chiefly grouped.

3. That local spasm with resultant anæmia is a probable cause of the chronicity of ulcer, aided by factors such as retention and infection set up by reflex spasm.

4. That certain of the 'gastric neuroses' may be exactly simulated by the resection of either the vagi or the splanchnic nerves.

5. That the results of nerve stimulation and therefore of nerve irritation can also simulate certain of these 'neuroses'.

6. That the phenomena grouped under the title of the 'nervous dyspepsias' or 'gastric neuroses' may have at least three sources of origin; and that certain of these conditions will probably come to be regarded as pre-ulcerous. These sources are: (*a*) Peripheral irritation of the nerves, manifested by gastric signs and symptoms. The site of irritation may lie in the stomach and may set up both local and reflex disturbances, or be situated more remotely, as in the gall-bladder, then producing reflex gastric troubles. (*b*) Lesions of the nerve paths. (*c*) Central disorders, possibly of endocrine origin.

7. That as a logical sequence of the foregoing, operations upon the nerves are indicated in certain disorders and diseases of the stomach.

8. That such operations are feasible, that in animals their results may be forecast, and that certain of them have been performed on man.

Two operations have been suggested based on these findings; one especially suited to the condition of pylorospasm, the other to that of cardiospasm.

I desire to express my thanks to my colleagues Dr. B. A. McSwiney and Professor J. S. B. Stopford for permission to utilize in this paper the results of work performed with them. I also wish to express my indebtedness to Dr. J. M. Woodburn Morison for his assistance, especially as regards the remarks on the X-ray findings, and to Mr. G. L. Brown for his kindness in examining the stomach musculature of certain of the operated animals. For the drawings I am indebted to Professor Stopford.

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SOLITARY HÆMORRHAGIC CYSTS OF THE KIDNEY: WITH REPORT OF A CASE ORIGINATING IN A CAVERNOUS HÆMANGIOMA.

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Lancereaux as early as 1876 divided the large isolated cysts of the kidney into two classes—serous and hæmorrhagic. The so-called serous variety is well known, and a large number of articles and case reports have recently appeared in the literature. Rarely, the contents of these cysts are blood-stained, but it is not this condition that is referred to in the term 'hæmorrhagic cyst'. Whatever the etiology of the latter may be, it seems to be undeniable that a group of cases have been reported from time to time with similar clinical symptoms and pathological appearances in the diseased kidney warranting the formation of a separate group.

Brin,[1] in his article on this subject, has reviewed eight cases selected by Souligoux and Gouget[2] from the whole of the previous literature as examples of true hæmorrhagic cysts, and has added four subsequent cases, bringing the literature up to date. On a basis of these twelve cases the following description is given:—

> "The cysts are solitary, and their size as a rule is large. Their extirpation is difficult on account of adhesions to the surrounding organs. The cyst wall is whitish, and the contents consist of red or blackish fluid with old brownish clots. The latter may be black in colour, or they may be of white fibrin. The cavity of the cyst is received into the rest of the kidney substance as an egg into an egg-cup. Its wall is continuous with the outer surface of the kidney, without any obvious ridge of demarcation. The internal surface of the cyst wall is irregular and festooned with clots, of which the most superficial are of a dark-red or blackish colour, and the deepest, grey-white, formed of fibrin, and intimately adherent to the fibrous lining of the cyst. The wall is always much thicker than in the case of the simple serous cysts, and may reach 5 mm. or even 1 cm. in width.
>
> "Microscopically three layers can be distinguished: (1) An inner layer of clots and fibrin; (2) A middle fibrous layer; and (3) An outer layer formed by renal parenchyma atrophied and sclerosed.
>
> "Both the part of the kidney containing the cyst and the rest of the organ are clothed in a fibrous capsule of normal thickness. There is rarely a communication with the kidney pelvis."

It is clear that this description refers to a condition totally different from the solitary cyst, which is thin-walled, projects from the surface of the kidney, and is clothed neither in compressed renal substance nor in fibrous capsule. Although full microscopic study was not made in each case, yet Brin is concerned in his series not to include cases of broken-down tumour forming cysts, or cases of hæmatonephroses and traumatic pararenal cysts, some of which have been reported under the caption of 'hæmorrhagic cysts of the kidney'.

The specimen from the case which is here reported corresponded exactly to Brin's description, and seemed in general appearance to duplicate the case from Rafin's clinic illustrated in Giuliani's report,[3] so that it seemed advisable to report it as a 'hæmorrhagic cyst'. The subsequent investigation showed that the primary condition was an angioma, but the end-results are such as I think have never been described, and a full description may shed some light on the etiology of the excessively rare condition of 'large hæmorrhagic renal cyst'.

CASE REPORT.

McM., age 33, labourer, was admitted to my care in the Wellington Hospital on Dec. 16, 1924. He complained that while lifting a heavy milk-can two years ago, he felt that something had given way in his side. Hæmaturia set in the same night. The blood was well mixed, and neither then nor subsequently were any clots passed. He was put to bed by his doctor, and after a few days' rest the bleeding ceased. He avoided heavy lifts for eighteen months, and then, following another 'strain', hæmaturia recommenced and has persisted almost without intermission until the time of the examination. He has never had frequency, dysuria, or any difficulty in passing water. There has been no pain in either loin. His medical attendant reports that hyaline casts were found in the urine in the interval between the first and second attacks of bleeding.

The previous history and family history present no important features. He has at times been addicted to alcoholic excess.

On Examination.—The patient was a sturdy, well-built man, with good muscular development; well nourished, and marked absence of wasting; very anæmic. Nothing abnormal in heart or lungs, or nervous system. Muscular development prevented a very satisfactory abdominal examination, but neither kidney was palpable or tender, nor was there any tenderness or pain in the costo-vertebral angles. There was no dullness in the suprapubic region. Per rectum, the prostate, vesicles, base of the bladder, and lower end of the ureters appeared to be normal.

Blood-pressure.—Systolic 120, diastolic 80.

Urine.—Specific gravity 1018. Acid. Blood obviously present and well mixed. Albumin: a trace. Sugar: nil. Microscopically: red corpuscles, a few white, a few hyaline casts. No bacteria in smear or culture.

Cystoscopic Examination.—The urethra admitted a No. 18 F. cystoscope without difficulty. The bladder appeared to be normal in all parts, including the ureteric orifices. Efflux on the right side, every 20 seconds; on the left, every 15 seconds. Blood was easily seen in each efflux from the right side, while those from the left were clear. Indigo-carmine (10 c.c. intravenously) appeared in four minutes from the left side, in seven from the right. In the latter case the dye was in somewhat less concentration. Total kidney function: phenolsulphonephthalein, 60 per cent in two hours.

Provisional Diagnosis.—'Hæmorrhagic nephritis' (essential hæmaturia) or neoplasm. The presence of casts, the long duration, and the complete absence of clots favoured the former.

The patient was so exsanguinated that further delay for investigation seemed dangerous, and operation was advised.

Operation.—Under nitrous oxide and ether the kidney was exposed by the method of Bazy, the peritoneum at the inner angle of the wound being opened in order to ascertain the absence of metastases in glands and other organs. The opening in the peritoneum was then closed, and the right kidney removed extraperitoneally. The lower pole, which was cleared with some difficulty, was hard, white, and covered with dense fibrous tissue. It had one or two small bosses upon it. Owing to the thick wall and the pressure of the contained fluid, the impression was given that one was dealing with a solid tumour. The mass extended to a little above the hilum, and above this level the kidney appeared to be normal. Access to the pedicle was somewhat difficult, as the hilum lay in a deep recess formed by the angle between the large mass below and the upper pole above, while the renal vein was very short. An accessory artery going to the upper pole caused some embarrassment before hæmostasis was secured. A pint of whole blood was given intravenously and the patient left the table in fair condition. Recovery was rapid and convalescence uneventful.

Fig. 421.—Hæmorrhagic cyst in lower pole of right kidney.

The Specimen.—The upper pole is normal in size and appearance, and the fibrous capsule thin and smooth. The lower pole (*Fig.* 421) is entirely occupied by a cystic tumour 11 cm. in diameter. The wall of the cyst is definitely fibrous, and varies in thickness between 1 mm. and 2·5 mm. On incising the tumour, 250 c.c. of dark fluid blood and tarry clot escaped. The internal lining of the cyst is smooth and glistening, except where masses of fibrin and clot are adherent. No dilated veins and no focus of bleeding are apparent in the cyst wall. The upper major calix of the kidney pelvis is normal, the lower is absent. A slight connection exists between the upper part of the cyst and the pelvis through which a bristle can be passed. At two points bosses project externally. At the upper part the cyst is separated from the rest of the kidney substance by its laminated fibrous wall, and the part of the kidney immediately adjacent to this appears to be pale and compressed. The internal measurements of the cyst are 9·2 cm. from above down, and 6·8 cm. in the other two diameters. The whole was covered by the fibrous capsule of the kidney, which passed without interruption into the capsule of the sound part of the organ.

Microscopical Examination.—"The cyst wall shows much free and partly organized blood, beneath which are a series of large intercommunicating blood spaces lined by endothelium (*Fig.* 422). In those parts which appear

to have been subjected to pressure, the blood spaces are obliterated, and there are then seen close masses of spheroidal cells with fine slit-like spaces throughout. Lying in the midst of and at the periphery of the cyst lining there is much old blood pigment, some of which lies in phagocytes. In no place is there any infiltration of the capsule, which consists of laminated fibrous tissue. Near the junction of the kidney proper and the tumour there can be seen flattened and compressed glomeruli in the fibrous capsule. The adjacent kidney cortex shows infiltration with small groups of inflammatory cells."

In certain places what appeared to be the original lining of the lower calix in the shape of definite transitional epithelium could be seen, outside the angiomatous structure. Outside the laminated fibrous wall of the cyst definite compressed renal tissue could be made out, and, beyond that again, the fibrous capsule of the kidney.

The specimen was reported as a *cavernous hæmangioma* giving rise to a blood cyst. It is probable that an angioma arising in one of the papillæ had bled into the lower major calix; then the outlet of the latter into the main pelvis became obliterated either by the growth or by organized clot. In consequence distention gradually took place, and this, either by itself or aided by the progress of the tumour, obliterated the minor calices, and the reaction of the tissues by reinforcing the wall of the large calix formed the laminated fibrous cyst wall as found. This sequence of events seems to be a reasonable supposition.

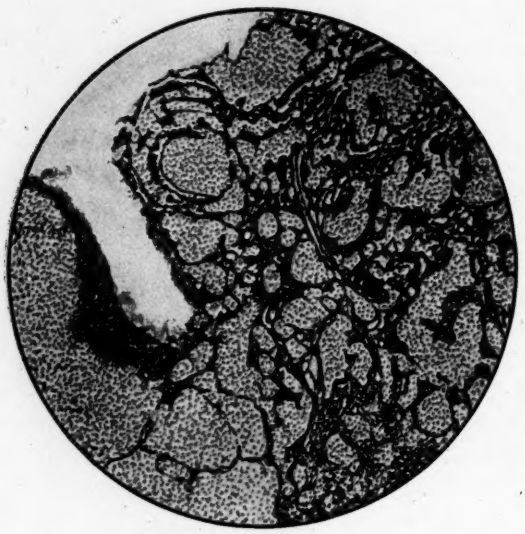

FIG. 422.—Section through angioma in wall of cyst, showing wide blood spaces.

The description of the microscopical examination is that of Dr. P. P. Lynch, Pathologist to the Wellington Hospital, to whom I am indebted for a careful examination of the slides and specimen.

The analogy between this case and that of Giuliani mentioned above is striking, not only in the general similarity in appearance of the specimens, but also in the fact that both were accompanied by hæmaturia. In fact, Giuliani's case was the only one in Brin's series that presented this symptom. To the naked eye both specimens, to judge from the illustration, are identical, and in the case of McM. it was only by a somewhat searching microscopical examination that the angiomatous formation was found. It is possible to conceive that, with the growth of the cyst, cellular elements that might have been concerned in its origin could disappear, so that eventually there would be no evidence that the cyst arose from an angioma.

I think that these two cases must be considered as examples of partial hæmatonephroses, due to bleeding from an angioma into the lower major calix, with results outlined above. The condition of partial hydronephrosis is rare, but a case is reported by Bazy.[4] It seems to me that the closing of the outlet of one department of the pelvis would more probably take place where some neoplasmic or clot formation was present than in a simple case, but either condition must be of excessive rarity.

Etiology of Hæmorrhagic Cysts.—Most of the theories of origin hitherto suggested have been unsatisfactory and inapplicable. The following suggest themselves for critical examination :—

1. *Bleeding into a Solitary Serous Cyst.*—It has been frequently stated that hæmorrhagic cysts are merely a form of serous cyst where bleeding has occurred. While it is no doubt true that the fluid in some of these cysts is blood-stained, their nature is totally different. The presence of the thick fibrous wall, compressed renal substance, and the fibrous capsule of the kidney itself, between the cyst content and the kidney surface—these are features quite foreign to the simple cyst.

2. *Trauma Causing an Effusion of Blood into the Kidney Substance with Encapsulation.*—The history of trauma is absent in most of the cases, and, even where it occurs, the bleeding would cease, and the resulting cyst contain the usual straw-coloured fluid common to old traumatic blood effusions, while a history of hæmaturia at some time would be the rule. Continuity of bleeding, and not only a single hæmorrhage, is essential for the formation of the large blood cysts.

3. *Aneurysm of one of the Minor Renal Vessels.*—The appearance of the cyst wall with its smooth surface and clinging masses of fibrin might suggest the possibility of this explanation; but apart from the difficulty in conceiving that such a tiny vessel should expand to this size, pulsation has never been recorded, nor is it likely that an aneurysm would limit itself so exactly to the confines of the kidney.

4. *Partial Hæmatonephrosis.*—By far the most probable explanation to my mind of all the cases is the one suggested previously, namely, partial hæmatonephrosis. The bleeding may have taken place as the result of an angioma as in my case, or followed one of the various obscure local conditions that, apart from 'nephritis', may cause 'essential hæmaturia'—varices round a papilla, minute papillomata, etc.

In the vast majority of cases the blood would pass into the pelvis without retention; but in some few either the factor that causes partial hydronephrosis may be present—whatever that may be—or the narrow outlet may be closed with clot adhering to the pelvis lining. In this case the gradual organization and augmentation of the clot would cut off the affected calix—major or minor—from the main pelvis, and the continued bleeding would cause distention of the closed cavity. Slight hæmaturia which would be present in the initial stages might easily pass unnoticed.

Apart from this distention of an excluded calix, it is quite conceivable that a small angioma might bleed into the kidney substance, causing a cyst, and that the neoplasm, while still present about the wall of the cyst, might be obscured in masses of organized clot and fibrin. The furious bleeding that

occurred in some of the cases where an attempt was made to dislodge these fibrinous masses is confirmatory of the hypothesis.

The etiology suggested would readily account for the layer of compressed renal substance that surrounds the cysts. In some cases of partial hæmatonephrosis a severe muscular strain, causing compression of the enlarged kidney, might re-open a passage to the pelvis, and bleeding would continue to take place externally, producing hæmaturia. This seems to be the only explanation in the case of McM.

Diagnosis.—This is similar to that of serous cysts except where hæmaturia is present. In the latter case the bleeding kidney is located and the condition discovered at operation. In the absence of palpable tumour or hæmaturia, more relative decrease in function may be expected than in the case of serous cysts, as more of the kidney substance is involved. Pyelography is more likely to give information, as some portion of the renal pelvis is almost certainly involved.

Conditions to be distinguished from 'large solitary hæmorrhagic cysts' are :—

1. *Cystic Degeneration of a Neoplasm, usually a so-called Hypernephroma.*—Here the lining is ragged and composed of tumour substance, while the presence of a growth is as a rule obvious. There is a complete absence of the very definite fibrous lining, smooth and even glistening on its inner surface, in parts where clot is absent, which is one of the characteristics of blood cysts.

2. *Hæmatonephroses.*—A number of cases where a hydronephrosis has contained bloody fluid have been encountered, and this is not surprising when one considers the frequency with which bleeding is associated with simple hydronephrosis, and that not only when the latter empties itself, but even when it is of the closed type. There would be no difficulty in differentiating such a condition involving the whole kidney from a localized cyst.

3. *Traumatic Pararenal Cysts.*—These are not covered by the fibrous capsule of the kidney in continuity as in the case of the true cyst.

Treatment.—If the cyst has attained any size, operation will clearly be indicated, either on account of pressure symptoms or to clear up the diagnosis. In the case of hæmaturia interference for the latter reason is imperative, and in some cases will be urgent, in order to stop hæmorrhage.

The conservative operations so frequently attended with brilliant results in the case of simple cysts have no place here. In favourable cases partial nephrectomy might conceivably be sufficient if the real condition were known ; but it is just this and the etiology that must be so much in doubt, that only complete nephrectomy will satisfy the conscience of the surgeon. Where attempts have been made to turn out the cyst contents, alarming hæmorrhage has always necessitated a rapid nephrectomy—a fact which points to an angiomatous basis for the condition.

SUMMARY.

1. Large solitary hæmorrhagic cysts (*les grands kystes hématiques*) are excessively rare. They have few characteristics in common with solitary simple cysts (*les grands kystes séreux*), and should be placed in a separate category.

2. They are different in nature from blood cysts caused by the degeneration of malignant tumours, from hæmatonephroses, and from traumatic pararenal cysts.

3. The suggestion is made that these cysts are of the nature of partial hæmatonephroses, where the source of the bleeding remains active over a long period of time. This source may be in the papillæ of the involved portion of the pelvis, and in the case reported an angioma was demonstrated.

4. In some instances the cyst may owe its origin to an angioma in the kidney substance itself.

5. The diagnosis is obscure, and the treatment is total nephrectomy.

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[2] SOULIGOUX and GOUGET, "Contribution à l'Étude des grands Kystes hématiques simples du Rein", *Arch. gén. de Méd.*, 1882, ii, No. 14, 833.
[3] GIULIANI, *Jour. d'Urologie*, 1913, March, 175.
[4] BAZY, *Encycl. franç. d'Urologie*, iii, 175.

OBSERVATIONS BEARING UPON THE OPERATION OF PROSTATECTOMY.*

By I. COHEN, E. C. DODDS, and C. H. SHORNEY WEBB, London.

The majority of surgeons will admit the difficulty of ascertaining the state of the renal function from a purely clinical inquiry, and they will agree that some additional test in the form of a laboratory examination is necessary. Owing to the variety of tests at present in use it is very difficult for any single observer to possess an intimate knowledge of all, with the result that each worker adheres to some test of which he has special experience. It will perhaps be as well to review very briefly these various tests, and to epitomize the current opinion upon them. It is not proposed here to enter into a detailed classification of the various tests, but merely to refer to them singly.

To commence with, practically all authorities are agreed that the mere examination of the urine for albumin, casts, pus, organisms, and other abnormal constituents, although important, is not reliable as a guide to operative prognosis, since it is quite possible to have very advanced renal changes coexisting with slight urinary alterations. Moreover, the results of back-pressure from prostatic enlargement or other causes rarely produce any marked changes in the urine.

A series of very important tests depends upon the administration of some natural or foreign substance and noting the excretion of the body in question. These are of two main varieties: first, those in which dyes are given, and, secondly, those employing substances such as urea, benzoic acid, phloridzin, etc. The dye tests in general use are the indigo-carmine and the phenolsulphonephthalein reactions. The former is usually performed clinically, and the excretion of each kidney can be investigated, either by means of the ureteric catheter or the cystoscope.

That the performance of some such test as this is an absolute necessity when dealing with unilateral lesions no one will doubt. In fact, this type of method constitutes the only one by which the individual functions of the kidney can be judged. The phenolsulphonephthalein test has proved reliable, but suffers from certain serious drawbacks. Thus the presence of blood in the urine renders the colorimetric estimation of the dye content exceedingly difficult, if not impossible.

Another test, used extensively in England, is the urea-concentration test of H. MacLean.[1] This test is of proved value in medical cases, but its value, when taken alone, in cases with obstruction, is not quite so certain. In *Table I* can be seen a comparison between the urea-concentration test and

* From the Biochemical Department of the Middlesex Hospital, London.

the figures obtained by blood analysis. By means of the administration of 15 grm. of urea, and the collection of the urine in three subsequent hourly specimens, the functional capacity of the kidney can be judged from the percentage of urea in the specimen.

Table I.—Blood-urea and Non-protein Nitrogen as Compared with the Urea-concentration Test.

Case	Blood-urea	Blood N.P.N.	Urine-urea Concentration Per Cent		
			Before Urea	1 Hour after	2 Hours after
	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.			
C. P.	32	63	2·6	3·2	3·5
T. L.	25	67	3·1	3·5	3·5
S. C.	40	64	0·9	1·2	1·3
A. H.	33	60	1·8	2·0	2·5
C. E.	70	66	4·2	3·8	4·4
J. W.	68	71	1·3	1·7	1·8
F. B.	28	42	1·1	1·4	1·9

To summarize briefly, it would appear that the mere examination of the urine alone does not form a sufficiently accurate means of estimating the renal function in relation to surgical conditions.

A whole series of new tests was opened up by the introduction of relatively simple and accurate methods of blood analysis. Mainly owing to the work of Otto Folin[2] and his school, it has been made possible to analyse about 10 c.c. of blood for a whole series of important constituents. Whereas the methods mentioned so far have tested the kidney as an eliminatory organ, any blood observation will measure retention of certain constituents due to some defect in kidney function. The blood content of the following substances has received most attention. They are given below, together with the normal percentage in the blood :—

Urea	20 to 40	mgrm. per 100 c.c. of blood	
Non-protein nitrogen ..	20 to 40	,,	,, ,,
Creatinine	1 to 1·5	,,	,, ,,
Uric acid	2 to 3	,,	,, ,,
Amino-acid nitrogen ..	4 to 7	,,	,, ,,
Sugar	80 to 120	,,	,, ,,
Chlorides as NaCl	400 to 500	,,	,, ,,

The estimation of each of these substances has been claimed as the ideal kidney function test by different authorities. Thus MacLean (loc. cit.) and De Wesselow,[3] in their books, review the literature very fully, and maintain that the urea content of the blood is the most valuable guide to prognosis. The latter authority, in considering the advisability of an operation for

removal of the prostate, states: "In cases in which the blood-urea content exceeds 50 mgrm. per 100 c.c., a two-stage operation is advisable"; and if the figure lies between 35 and 50 mgrm. per 100 c.c., clinical evidence and other tests must be relied upon.

The American workers maintain that a more complete examination of the blood should be performed. Folin (loc. cit.) suggests that all the constituents tabulated above should be estimated, and opinion should be passed upon the general consideration of the nitrogen distribution.

Frontz and Geraghty[4] state that the most useful information is gained from the non-protein nitrogen and uric-acid contents. They disregard urea. Myers and Fine,[5] and Berglund[6] suggest that the estimation of creatinine is of the greatest importance, and that a figure of persistently over 1·5 mgrm. per 100 c.c. must be regarded as evidence of serious renal damage.

It is necessary to distinguish between nitrogen retention due to permanent destruction of kidney substance as seen in chronic nephritis, and that due to back-pressure from some genito-urinary obstruction. In the latter case continued obstruction eventually leads to permanent impairment of function, but the removal of the obstruction to urinary outflow will, if performed early enough, lead to an improvement in the excretory power of the kidney. Johnson's[7] experiments showed that after tying the ureter, and thus causing complete obstruction, function could be regained even after fourteen days when the ligature was removed.

Many of our cases as recorded later showed marked decrease in nitrogen retention where bladder drainage was resorted to. It is conceivable that tests like that of MacLean might be obscured by the difficulty in efficient emptying of a vesiculated bladder. Coming to the blood estimation, the argument that the figures obtained may give no information in unilateral lesions does not hold when the question is only whether there is enough acting kidney substance in the body to warrant the risk of the operation of prostatectomy.

The investigations about to be described were commenced three years ago. It was felt that there was insufficient knowledge on the problem to rely on any one blood constituent, and that the best interests would be served by performing as complete analyses as possible in every case. By this means it was thought that after a large number of cases had been examined the diagnostic significance of each constituent would be judged. Where pre-operative figures were raised, wherever possible we suggested drainage of the bladder by means of a suprapubic cystotomy before proceeding with prostatectomy.

Out of our series of 69 cases, in 54 all the blood constituents mentioned earlier were estimated. In the others only urea, or urea and non-protein nitrogen determinations, could be made, owing to small quantities of blood. It was decided to classify the results into three groups: (1) Those in which only one blood analysis was performed; (2) Those showing no benefit from suprapubic drainage; (3) Those in which the effect of suprapubic drainage was found to be successful, as judged by two or more analyses. Owing to the large number of figures, it was found possible only to publish representative examples of each group.

Group I.—With regard to this group—that is, those cases in which only one blood analysis was performed—*Table II* shows the result of blood analyses upon a series of unselected cases prior to operation. For one reason or another a second blood analysis could not be performed. It will be noted that in some cases prostatectomy was performed, although the blood figures were in the danger zone. In other cases drainage, either temporary or permanent, was instituted, although the figures were well within

Table II.—Cases with One Set of Figures.

Case	Urea	N.P.N.	Creatinine	Uric Acid	Amino-acid N.	Sugar	Chlorides	Remarks
	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 cc..	Mgrm. per 100 c.c.	
W. F.	34·0	37·0	2·0	2·5	5·0	125	462	Permanent drainage
C. P.	32·0	63·0	1·6	3·7	11·0	99	462	Prostatectomy
W. P.	23·0	67·0	1·5	2·7	7·0	134	450	Prostatectomy
T. L.	25·0	67.0	1·6	2·9	11·3	143	379	Prostatectomy
G. G.	32·0	29·0	1·4	1·6	5·4	112	388	Patient unsuitable for prostatectomy. Double Steinach operation performed
A. H.	33·0	60·0	—	—	—	114	—	Suprapubic cystotomy and prostatectomy 7 days later
W. H.	52·0	58·0	1·1	2·8	7·6	98	413	Cystotomy and prostatectomy 16 days later
F. H.	41·0	55·0	1·9	2·6	10·0	103	429	Suprapubic prostatectomy
C. Q.	29·0	40·0	1·6	4·0	5·9	101	462	Expectant treatment. Patient unsuitable for operation
C. K.	38·0	48·0	2·0	2·6	8·1	87	470	Suprapubic cystotomy
E. B.	30·0	53·0	1·7	2·6	8·2	98	—	Prostatectomy
J. M.	97·0	82·0	2·3	4·9	5·9	146	445	Cystotomy. Died of uræmia

normal limits. In these instances the surgeon was guided by the general condition of the patient irrespective of laboratory findings. One of the first points striking the observer is that the values for the various constituents do not rise or fall together. Thus, in one case the blood-urea and non-protein nitrogen contents may be low, whilst the creatinine is high, or vice versa. The sugar content varies quite independently of the renal condition, whilst the chlorides and amino-acid nitrogen bear little or no relation to the clinical condition.

It would appear, therefore, that only the urea, non-protein nitrogen, creatinine, and uric acid remain for consideration. If the table be inspected further, it can be seen that the non-protein nitrogen and uric acid content vary in roughly the same manner, and that the creatinine content is always above normal when the former are high, but the reverse does not necessarily hold true. Although in advanced conditions the urea content is high, many of the cases show a normal content, even when the other constituents are very much above normal. This would narrow the choice down to non-protein nitrogen and uric acid. A careful inspection of all the figures will show that these two values are the most constantly raised in conditions associated with renal disturbance, and, if these be taken as a guide, it might reasonably be expected that as few mistakes as possible would then be made.

After having decided that the non-protein nitrogen and uric acid content are the most reliable, the next problem is to fix danger limits for operation.

Table III.—Cases not Yielding to S

Case	Before Cystotomy						
	Urea	Non-protein Nitrogen	Creatinine	Uric Acid	Amino-acid Nitrogen	Sugar	Chlo
	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. 100
R. B.	38·0	50·0	1·1	3·1	6·6	120	2
			6 days later				
	64·0	50·0	1·2	3·3	—	87	4
F. B.	28·0	42·0	1·1	4·1	6·8	86	4
G. N.	60·0	77·0	1·9	3·1	6·4	85	5
J. L.	119·0	118·0	2·1	5·9	4·4	127	4
W. M.	No figures before drainage						

Group II.—In *Table III* are included the results from a series of cases either proving fatal or not yielding to suprapubic drainage.

Case W. M. (*Table III*) shows a series of analyses upon a man after suprapubic drainage. After ninety days the non-protein nitrogen was much above normal (76 mgrm. per 100 c.c.), whilst the urea was normal. He was operated upon, a suprapubic prostatectomy being performed, and he died immediately after.

At the post-mortem examination the kidneys showed advanced fibrotic changes.

Case G. N. (*Table III*) showed a fall in his urea content from 60 to 51 mgrm. per 100 c.c., but the non-protein nitrogen remained 60 mgrm. per 100 c.c. Prostatectomy was performed, and he died of uræmia nine days later.

We have examined a series of nine fatal cases, in all of which the non-protein nitrogen content was above 60 mgrm. per 100 c.c.

IELDING TO SUPRAPUBIC DRAINAGE.

	After Cystotomy							Remarks
Chlo	PTER TOMY	Urea	Non-protein Nitrogen	Creat-inine	Uric Acid	Amino-acid Nitrogen	Sugar	Chlorides	
Mgrm. 100		Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	
28	—	—	—	—	—	—	—	—	—
48	7	52·2	54·6	—	—	—	—	—	Suprapubic prostatectomy
	9	37·8	52·2	—	—	—	—	—	
49	9	25·8	42·3	1·5	3·9	6·9	115	379	Cystotomy performed, prostatectomy being difficult
54	6	64·2	61·5	—		5·0	110	—	Died after prostatectomy done nine days after last figure
		51·4	60·3	2·1	2·8	7·2	100	—	
44	5	131·9	137·5	2·9	4·5	8·4	105	429	Died of uræmia
	8	159·3	106·7	—	—	—	—	—	
	5	110·7	85·3	—	—	—	—	—	Treated as in-patient
	22	90·0	87·5	—	—	—	—	—	
	29	112·0	84·0	—	—	—	—	—	
	36	114·0	80·0	—	—	—	—	—	
	36	84·0	66·3	—	—	—	—	—	Treated as out-patient
	0	36·0	75·6	—	—	—	—	—	Admitted and operated on Died of uræmia

Group III.—On turning to *Table IV*, which deals with cases operated upon successfully and yielding to suprapubic prostatectomy, it can be seen that suprapubic drainage produced a marked reduction in the figures, and

Table IV.—Cases Yieldi

Case	Before Cystotomy						
	Urea	Non-protein Nitrogen	Creatinine	Uric Acid	Amino-acid Nitrogen	Sugar	Chl
	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgr 10
J. S.	44·0	51·0	1·3	2·8	6·3	114	
A. W.	161·0	141·0	1·1	2·5	11·2	143	
H. S.	36·0	58·0	1·3	2·6	5·1	113	
F. S.	29·0	81·0	—	—	—	—	
L. W.	49·0	42·0	1·3	2·6	5·3	98	
A. S.	68·0	133·0	—	—	—	—	
C. E.	70·0	66·0	1·6	2·3	6·3	106	
F. C.	71·0	77·0	—	—	—	—	
F. W.	34·0	52·0	1·3	2·3	4·8	106	
R. G.	121·0	109·0	3·1	3·8	7·9	133	

DISCUSSION OF RESULTS.

An examination of the results points to the fact that the retention of non-protein nitrogen and uric acid is far more constant in cases of renal damage (as judged by post-mortem and clinical post-operative evidence) than the other constituents. By far the most important object is to fix a definite figure at which a two-stage operation should be advised. It would appear that the danger point lay round 50 mgrm. per 100 c.c. for non-protein nitrogen, and about 3·5 mgrm. per 100 c.c. for uric acid content. It must be admitted that occasional odd cases have gone through perfectly normally with figures above these, but against these must be contrasted the number who have either died or exhibited serious clinical symptoms.

As the result of these investigations we have worked upon the rule that figures of above 60 mgrm. and 3·5 mgrm. per 100 c.c. of non-protein nitrogen and uric acid respectively, indicate that a suprapubic cystotomy should be

that before the final operation for enucleation, the non-protein nitrogen content was below 60 mgrm. per 100 c.c.

TO SUPRAPUBIC DRAINAGE.

	AFTER CYSTOTOMY						
ER AFTER STOTOMY	UREA	NON-PROTEIN NITROGEN	CREATININE	URIC ACID	AMINO-ACID NITROGEN	SUGAR	CHLORIDES
	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.	Mgrm. per 100 c.c.
days	23·0	41·0	1·1	2·3	5·9	9·8	339
„	29·0	40·0	1·2	2·8	—	116	519
„	35·0	30·0	1·3	2·1	6·0	114	476
„	31·0	32·0	—	—	—	—	—
„	32·0	33·0	1·3	2·3	5·8	122	495
„	58·0	48·0	—	3·4	6·8	—	—
„	44·0	61·0	2·1	2·8	6·9	103	479
weeks	48·0	69·0	—	3·3	8·5	97	—
„	30·0	50·0	—	—	8·0	98	—
months	38·0	45·0	—	—	—	141	—
days	42·0	49·0	1·5	1·8	8·5	96	363
„	33·0	44·0	—	—	—	—	—
„	24·0	38·0	2·4	3·6	5·4	79	485
„	61·0	59·0	2·0	3·2	4·9	98·5	528

performed, and, after drainage, the blood figures will usually sink to below these limits, when enucleation may be performed. When the high figures persist in spite of this preliminary treatment, any major operation is contra-indicated, as the kidneys have become permanently damaged.

That the striking clinical benefit so frequently seen after a suprapubic cystotomy is accompanied by a corresponding improvement in the nitrogen retention can easily be seen from *Table IV*. In one case, A. W. (*Table IV*), the figures before the operation were 161 mgrm. of urea and 140 mgrm. non-protein nitrogen respectively. Fourteen days after operation these had fallen to 29 and 39 mgrm. per 100 c.c. respectively. Cases of this nature are extremely common, and in the majority of patients suprapubic drainage is followed by almost immediate improvement.

It would appear that the actual operation for prostatic enucleation adds about 20 mgrm. to the figures for urea and non-protein nitrogen; if then they were high before, the increase may be sufficient to endanger the patient.

With regard to the relative advantage of purely clinical observations over purely laboratory tests, it is a difficult matter for us to express a definite opinion.

Table V.—Comparison of Blood-urea and Non-protein Nitrogen Figures with Duration of Symptoms.

Case	Age of Patient	Duration of Symptoms	Blood	
			Urea	Non-protein Nitrogen
			Mgrm. per 100 c.c.	Mgrm. per 100 c.c.
W. F.	72	2 months	34·0	37·0
A. G.	51	10 months	39·0	86·0
J. W.	71	12 months	80·0	113·0
R. B.	71	2 years	38·0	50·0
W. R.	78	5 years	102·0	—
W. H.	67	6 years	52·0	58·0
F. B.	57	7 years	28·0	42·0

A study of the history of our cases would seem to indicate that the duration of the complaint plays a very small part in determining the amount of retention, as will be seen in a few cases shown in *Table V*. It is also remarkable that these back-pressure cases often show slight general symptoms with urea and nitrogen figures as high as those usually associated with uræmia, for example:—

Case A. W. (*Table IV*): Urea 161, non-protein nitrogen 140.

Case R. G. (*Table IV*): Urea 121, non-protein nitrogen 109.

There can of course, be no doubt but that the closest co-operation between the laboratory and the surgeon is the only method of reducing errors of judgement in these cases to a minimum.

CLINICAL ASPECT.

The operation of prostatectomy may be productive of considerable shock to the patient—shock of two kinds: (1) General surgical shock such as may be produced by almost any major operation; (2) Urinary shock such as may be directly consequent upon any major operation on the urinary tract, ending possibly in uræmia. Clinicians often lose sight of the importance of the first type, in their eagerness to investigate the possible occurrence of the second.

It is without doubt true that a knowledge of the state and efficiency of the kidneys is of paramount importance in determining whether the removal

of the prostate is likely to induce much or little urinary shock—with possibly complete or partial suppression of urine. It is also wise to bear in mind the injurious effect of a general anæsthetic upon an inefficient kidney. An estimation of the 'renal efficiency' is always necessary in order that the surgeon may decide whether the removal of the prostate is feasible, and whether the removal should be performed in one or two stages.

It is not, however, altogether enough to rely on the laboratory figures of the renal function in order to arrive at a decision as to whether the prostate can be removed or as to how it should be removed. The clinical picture of the patient is of as great an importance in arriving at an accurate estimation of his chances of survival after prostatectomy as in any major operation unconnected with the urinary tract. The clinical signs and symptoms which are of value in this estimation of the suitability of a case for a one- or two-stage operation are best grouped as given in the list below. Many of these only make their appearance when there is a fairly high degree of renal inefficiency present. Absence of such signs or symptoms favours a good prognosis, presence of them engenders caution.

1. *Age.*—This, being comparatively obvious, need not be enlarged upon.

2. *The Prostate.*—Some enlargements of the prostate lend themselves more easily to removal than others. Smooth, movable, elastic, moderate-sized enlargements are removed with greater facility than the small harder varieties, for instance. A large gland often shells out more easily than a small one.

3. *Desiccation.*—The patient is sometimes a dried-up shrivelled old man, with a dry wrinkled skin and little or no subcutaneous fat. Complaining of thirst, he shows a dry brown tongue and possibly cracked lips. The urine in this type of case is often of low specific gravity.

4. *Nutrition.*—Complaining of anorexia, nausea, and sometimes vomiting, the patient may be badly nourished and lacking in stamina, feeble and tottery. Constipation may be very troublesome.

5. *Fatigue.*—Sleeplessness by night, due either to frequent micturition or a definite insomnia, and drowsiness by day are not uncommon. There may be a low form of muttering delirium at night, with perhaps picking at the bedclothes. These mental symptoms may be intensified by the worry of an impending operation. Tremors of the hands and fingers may be present.

6. *Infection.*—Cystitis, pyelitis, *B. coli* infection of the urinary tract, calculi, prostatic or vesical, complicating prostatic enlargement, will generally influence the surgeon in the direction of a two-stage operation.

7. *Heart, Blood-vessels, Lungs.*—Cardiac disease, arteriosclerosis, and chronic pulmonary conditions must all be considered.

8. *Temperament.*—Best summed up in two words—fear and phlegm. The phlegmatic individual makes a far better patient than the nervous, timid type.

Laboratory investigations into the amounts of non-protein nitrogen, of blood-urea, or of uric acid will give no information as to the temperament of the patient, the state of his heart, blood-vessels, or lungs, his physical nutritional state or stamina, his robustness or feebleness, or, even less, the

condition of his prostate. The true perspective is to be found, first, in realizing the importance of the laboratory findings and in visualizing them in terms of renal function only, and, secondly, in turning elsewhere—i.e., to the bedside of the patient—for the absence or presence of those signs and symptoms upon which the most accurate estimation of the patient's chances of recovery from the two distinct forms of post-operative shock may be based. No wise surgeon allows the contemplation of his patient's kidneys to mask the picture of his patient as an individual.

SUMMARY.

1. Owing to the lack of uniformity of views upon the value of renal function tests in relation to prostatectomy, an investigation of a series of cases was instituted.

2. For various reasons detailed in the text it was decided to concentrate the observations upon blood analysis.

3. From a study of the figures obtained in relation to after-history, it was found that the non-protein nitrogen content and uric-acid content of the blood formed the best guide to prognosis.

4. The upper limit of safety for the complete operation of prostatectomy was found to be 50 mgrm. per 100 c.c. for non-protein nitrogen, and 3·5 mgrm. per 100 c.c. for uric acid.

5. Experience has shown that if figures above these are encountered, the performance of a preliminary suprapubic cystotomy is advisable. The enucleation can then be carried out when the figures fall within the limits of safety.

6. The blood-urea content is much more unreliable than the non-protein nitrogen and uric-acid contents. A high blood-urea content must always be regarded as a serious sign, but reference to the tables will show that a low urea content cannot always be regarded as an indication of a normal kidney function.

7. Laboratory findings should never be relied upon alone, but should always be considered in combination with the clinical state of the patient.

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PRIMARY TUMOURS OF THE URETER.*

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Primary tumours of the ureter are of rare occurrence. Writing in 1922, Aschner[1] collected the comparatively small number of forty-seven published cases, illustrative of the various types of epithelial tumour which have been observed. In the available literature the present writer has been able to find the records of a further five cases. From the clinical standpoint such tumours are of considerable surgical interest on account of the grave symptoms they may produce, the difficulties in accurate pre-operative or even operative diagnosis, the frequency of malignant change, and, lastly, the radical operative measures usually required in their treatment. For these reasons the following case appears worthy of record, illustrating as it does many features in the symptomatology, diagnosis, and pathology characteristic of the condition.

REPORT OF CASE.

A married woman, 75 years of age, was admitted to the Edinburgh Royal Infirmary on Nov. 22, 1924, being referred to the wards under the charge of Professor D. P. D. Wilkie. Her complaint was pain on the right side and hæmaturia, commencing eight months previously.

History.—For many years she had been subject to bronchitis and asthma. At intervals for about twenty years she had experienced attacks of hypogastric pain associated with dysuria and frequency of micturition. These attacks were generally very transient, usually nocturnal, and appeared to be brought on by cold. There had been occasional lack of vesical control, especially related to fits of coughing. A uterine prolapse complained of some years ago was relieved after wearing a pessary for a few months. During the last two years there had been chronic dyspeptic symptoms, associated with flatulence and constipation.

Present Illness.—In March, 1924, she was feeling somewhat run down in health. One morning she was attacked with sensations of shivering, malaise, and general pains, which appeared at first to be heralding the onset of influenza. Later in the day a pain commenced in the right loin, gradually increased in severity, and was felt shooting down towards the groin. Hæmaturia accompanied these symptoms, the urine being deeply blood-stained, but apparently no clots were passed. Varying in intensity, the pain and hæmaturia continued for three weeks, and were associated with frequency of micturition, especially if the pain was severe. In June there was another, but less severe, attack of hæmaturia and pain, which lasted for a week. There was no further obvious bleeding, but she complained of intermittent right-sided pain, which became severe in November. The urine was generally clear, but at times was noted to be turbid. Intermittent frequency of micturition was present, but the total amount of urine was not increased. She now noticed some slight loss of weight.

On Admission.—The patient was found to be a rather feeble old woman, bronchitic, with a poor appetite, and complaining of flatulent dyspepsia. The pulse was regular, with a well-sustained wave, and the arterial walls, as estimated from

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the radial at the wrist, were slightly thickened. Systolic blood-pressure was 140 mm. Hg. Abdominal examination revealed no renal enlargement. There was no superficial or deep hyperæsthesia, but tenderness was present on deep palpation in the right hypochondriac and lumbar regions. The liver was not enlarged, and there was no ascites. Splashing could be elicited in a somewhat dilated stomach. Chemical examination of the urine, beyond demonstrating a very faint trace of albumin, revealed no other abnormal constituent. The Wassermann reaction was negative.

Cystoscopic Examination.—On Nov. 24 a cystoscopic examination was carried out. The urine withdrawn from the bladder by a catheter appeared healthy, and was retained for purposes of examination. The bladder was then filled, and it

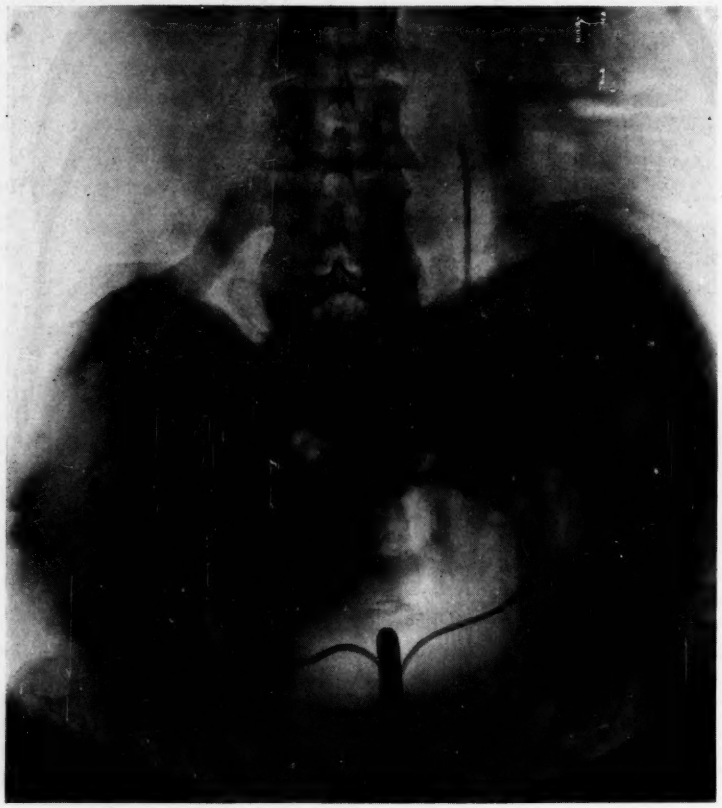

Fig. 423.—Prior to operation. Radiogram with opaque ureteral catheters introduced. The catheter on the right side is arrested at the level of the brim of the true pelvis.

was found to hold 300 c.c. without discomfort. An examining and catheterizing cystoscope was introduced, and the vesical walls were seen to be in the main healthy, with a depression posteriorly. The trigone on the left side was smooth and healthy, with the left ureteral orifice readily discerned and quite normal. In relation to the right ureteral orifice there was a localized area of pronounced bullous œdema and congestion. Opaque ureteral catheters were next introduced. On the left side the catheter easily advanced for a distance of 30 cm. On the right side the ureteral orifice was found with difficulty, and a catheter passed up it was definitely arrested at a distance of 15 cm. From the right catheter a small amount of blood-stained secretion was obtained; from the left the efflux was more copious, a little turbid, but not blood-stained. Specimens of secretion from both sides were collected.

Radiograms were then taken with the ureteral catheters *in situ*. The left

catheter was found to pursue a normal course up to the level of the 3rd lumbar vertebra. The right catheter was seen to be arrested at the level of the brim of the true pelvis; there was no evidence of calculus at this point (*Fig.* 423).

Twenty c.c. of 20 per cent sodium bromide solution was next injected into the right ureteral catheter without causing discomfort. The resulting ureterogram demonstrated a definite ureteral obstruction, some distance above the tip of the catheter, at the level of the lumbosacral articulation. At this point the ureterogram ended as a small sphere. A very faint shadow of bromide solution was observed in the renal pelvis, situated lower than usual, at the level of the 3rd lumbar vertebra (*Fig.* 424).

FIG. 424.—Prior to operation. Right-sided ureterogram after injection of a solution of sodium bromide. There is definite ureteral obstruction at the level of the lumbosacral articulation.

EXAMINATION OF URINE.—

Direct Films.—The left ureteral specimen contained numerous transitional epithelial cells but no organisms. The right ureteral specimen contained numerous transitional epithelial cells and red blood-cells. There were no cells suggesting malignancy, and no organisms were found. The bladder specimen contained red cells, a few epithelial cells, scanty polymorphonuclear leucocytes, and a few Gram-negative bacilli.

Culture.—On culture a growth of *Bacillus coli communis* was obtained from the bladder specimen, but no growth resulted from either of the ureteral specimens.

DIAGNOSIS.—From the symptomatology and investigation findings a diagnosis was made of tumour affecting the right ureter at the level of the 5th lumbar vertebra, probably originating as a primary growth in the renal pelvis, though possibly primarily situated in the ureter. Operation was advised.

OPERATION.—The patient was operated upon by Professor Wilkie on Nov. 27. Through the usual oblique loin incision the kidney, which was low and mobile, was exposed and easily delivered into the wound. The kidney was a little below the average size, and, apart from a small subcapsular cyst on its anterior aspect, it exhibited no abnormality. The renal pelvis was not dilated, and palpation revealed nothing to suggest a tumour in its interior. The ureter was followed downwards, and its upper 6 cm. was found to be healthy and of small calibre. Just below this level there was a fusiform swelling, measuring about 3 cm. in length, soft in consistency and yellowish blue in colour. There were no adhesions to the surrounding tissues, the outer coat of the ureter being perfectly intact. Below the level of this swelling the ureter again appeared perfectly healthy. No enlarged lymphatic glands were found.

FIG. 425.—Subsequent to operation. Radiogram with opaque catheter introduced into right ureter. The catheter passes up to nearly the same level as before operation.

In view of the patient's age and general condition, and also because the urological investigation had revealed an apparently normal ureter below this level, a complete dissection down to the vesical wall was not carried out. The ureter was divided a short distance below the tumour, its walls being examined and found to be healthy. The vessels of the renal pedicle were then ligated and divided, and the kidney with the portion of ureter attached was removed.

The patient made an uninterrupted recovery. No difficulty was experienced with micturition, and no blood, pus, or albumin appeared in the urine. She was discharged on Dec. 18, three weeks subsequent to her operation.

On April 9, 1925, she reported for examination. She stated that all her urinary

symptoms had been relieved. There had been no hæmaturia nor frequency, and her urine was now voided easily and without discomfort. She complained of occasional slight pain over the right iliac crest in the distribution of the gluteal branch of the last dorsal nerve. There had been no loss of weight.

On cystoscopic examination the bladder was found to be entirely healthy and of normal capacity. The bullous cystitis round the right ureter had quite disappeared, leaving a small orifice surrounded by flat, pale mucosa, in which a few slightly engorged blood-vessels coursed. A catheter passed up the right ureter with ease for a distance of 10·5 cm., where it was arrested. An X-ray photograph showed the catheter curving round from the beak of the cystoscope, and having its tip at a level a little below the brim of the true pelvis (*Fig.* 425). Six c.c. of sodium iodide solution was injected, and the resulting ureterogram demonstrated that the ureter filled evenly for a further 3 or 4 cm. The ureteral calibre was small, and there was no distortion or filling defect (*Fig.* 426).

FIG. 426.—Subsequent to operation. Right-sided ureterogram after injection of a solution of sodium iodide. The portion of ureter remaining is filling evenly throughout its course.

The urine was clear, acid in reaction, with a specific gravity of 1,006, and contained no abnormal constituents. Microscopically, one or two epithelial cells only were found; no organisms were obtained either on film or on culture.

PATHOLOGICAL FINDINGS.—The specimen was injected and fixed in Pick's solution. It was found that the amount of fluid required to fill the renal pelvis was 6·5 c.c., and that the ureteral lumen at the site of the tumour was so encroached upon as only to admit a very fine probe. After fixation, during the course of which a certain degree of contraction of the tissues took place, the whole specimen was bisected in the coronal plane.

Macroscopic Appearances (*Fig.* 427).—The kidney was small, and measured 9 cm. in length by 5 cm. in breadth. The cortex was narrow, and contained a small cyst 1 cm. in diameter, lying adjacent to the medulla, in the upper portion of the organ. There was an increase of peripelvic fat, but the pelvis itself was not dilated, its mucosa was healthy, and there was a well-marked constriction at the uretero-pelvic junction.

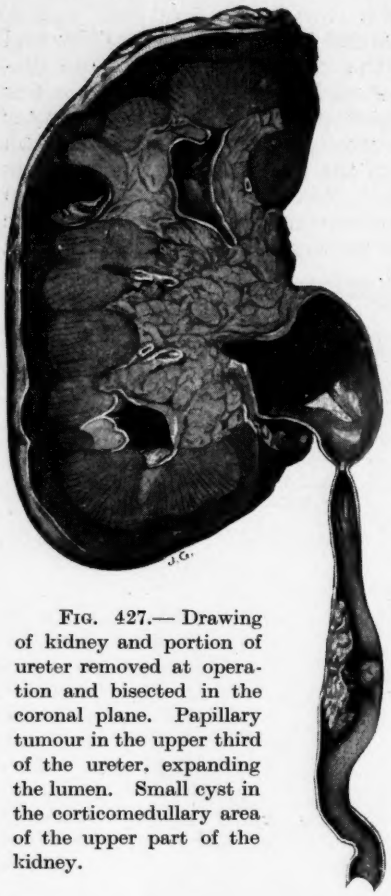

FIG. 427.— Drawing of kidney and portion of ureter removed at operation and bisected in the coronal plane. Papillary tumour in the upper third of the ureter, expanding the lumen. Small cyst in the corticomedullary area of the upper part of the kidney.

The upper 2 cm. of the ureter was narrow, 4 mm. in diameter, and appeared quite healthy. Below this, for a further distance of 2 cm., the ureter was dilated in a fusiform manner to over twice its diameter above, by a sessile papillary tumour, from which a pedunculated expanded growth was prolonged downwards into the lumen of the channel. The base of the tumour covered practically three-fourths of the circumference of the ureter and almost completely obstructed it. Externally the ureteral wall was somewhat congested, smooth and regular, and exhibited no induration. Immediately distal to the tumour the ureter regained its small calibre and healthy appearance, forming an S-shaped bend at a slightly lower level.

Microscopic Appearances.— In order to demonstrate the tumour in its entirety, the anterior half was utilized for complete longitudinal sections. These show the sessile nature of the proximal portion, while distally the tumour is prolonged as a fibrocellular, pedunculated growth, with normal ureteral wall on either side of it (*Fig.* 428).

Under higher magnification the distal portion evinced the characteristics of a proliferative type of benign papilloma, with hæmorrhagic extravasations towards its periphery, and at one point the formation of a cyst in the centre of an epithelial mass. At the growing margin (*Fig.* 429) the loose vascular, ramifying, connective tissue of the

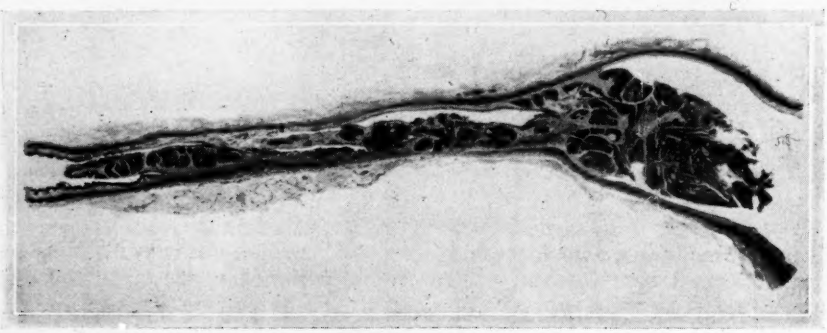

FIG. 428.—Longitudinal section of the tumour under low power. The tumour is sessile in its proximal portion and pedunculated distally. (× 3.)

neoplasm is seen to be continuous with the ureteral submucosa, and at this point there is a round-celled infiltration. Surmounting the stroma, and sharply demarcated from

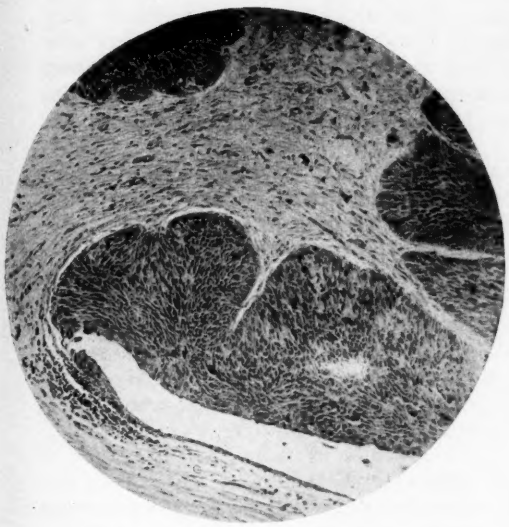

FIG. 429.—Section at the attachment of the distal pedunculated portion of the tumour to the ureteral wall. There is an inflammatory-celled infiltration of the submucous coat of the ureter at the growing margin of the tumour.

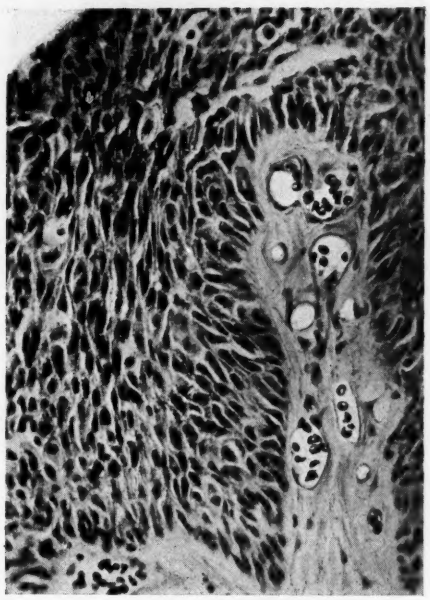

FIG. 430.—Drawing of a section of the distal papillomatous portion of the tumour under high power. The individual characteristics of the tumour-cells and their relationship to the stroma are seen.

FIG. 431.—Sessile proximal portion of the tumour. Invasion of the submucous coat of the ureter by two islands of tumour-cells, with a surrounding inflammatory-celled infiltration. The intact muscle coat is seen below.

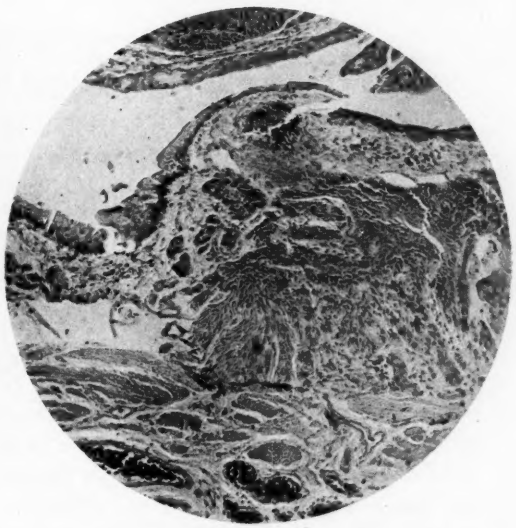

FIG. 432.—Sessile proximal portion of the tumour. Irregular strands of tumour-cells infiltrating the submucosa. A group of dilated blood-vessels in the ureteral adventitia is separated from the tumour by the intact muscle layer.

it, are the epithelial elements, several layers in depth. In the stratum adjacent to the stroma, the epithelial cells are elongated, whereas superficially they are flattened. In the intermediate area more variation occurs; thus, in the denser portions the cells are compressed and tend to be spindle-shaped, while in the looser portions they tend to be cuboidal or polyhedral. Individually the nuclei differ in shape and size, in accordance with the type of cell, and also show variations in their staining properties, some staining much deeper than others, while in a few there is a reticular formation of the chromatin. The cytoplasm is faintly granular and takes up the basophil stain poorly (*Fig.* 430).

The sessile proximal portion of the tumour, while still retaining its papillary nature, showed in places evidences of commencing infiltration, though at no point could this be found to penetrate beyond the submucous layer. The ureteral submucosa is invaded (*Fig.* 431) by two islands of tumour-cells, surrounded by an inflammatory cell reaction, the intact muscularis being seen immediately below. Similarly the submucous connective tissue, covered by more or less normal mucous membrane, is shown infiltrated (*Fig.* 432) by irregular strands of tumour-cells, some of which tend to be of an undifferentiated type. Again the process stops short of the muscle layer, and a group of dilated blood-vessels is seen in the ureteral sheath externally. Vacuolation and cyst formation were very definite features of this portion of the tumour. A large cyst is depicted (*Fig.* 433), lined by flattened cells, and with two ingrowths, the superficial cells of which are œdematous, swollen, and becoming detached. In the interior of the cyst are some swollen, degenerated tumour-cells and also a few erythrocytes.

FIG. 433.—Sessile proximal portion of the tumour. Cyst in the centre of the growth, containing swollen, degenerated tumour-cells and red blood-corpuscles.

Sections taken from the kidney revealed a moderate degree of chronic interstitial nephritis, commensurate with the age of the patient. The renal pelvis and ureter above the tumour showed no abnormality, but in the portion of ureter situated below the tumour there was slight congestion and an extensive round-celled infiltration of the submucosa and of the perivascular areas in the outer coat.

Conclusion.—Primary papillary epithelial tumour of the ureter, with cyst formation and evidences of early malignancy of a local character.

ETIOLOGY.

Mechanical irritation being such an important etiological factor in the production of tumour growth, it might be expected that ureteral neoplasms would be found existing as sequelæ to calculus formation. In 11 out of 54 cases calculi have been present. In certain instances, however, their etiological significance may be questioned, as it appears quite possible that they may have developed subsequent to the ureteral obstruction and urinary decomposition occasioned by the tumour, or that they have formed in the centre of a blood-clot enclosed by tumour growth. The latter possibility is

illustrated in Le Dentu's[2] case, where papillomatous growths were situated at the two extremities of the ureter, each containing a little mass of blood-clot in the centre of which was a small concretion the size of a hemp-seed. Occasionally, however, the constant irritation of an impacted calculus appears undoubtedly to have been of importance as a predisposing factor. In a case published by Metcalf and Safford[3] the patient had suffered for some years from attacks of renal colic and pyuria; he subsequently developed, at the lower end of the ureter, an adenocarcinoma surrounding an impacted oxalate stone. A very similar case was recorded by Davy.[4] In Aschner's case a carcinoma of the upper end of the ureter was associated with a state of leuco-plakia, infection, and calculus formation in the renal pelvis.

Calculus formation, apparently, is more frequently associated with malignant than with benign ureteral tumours.

Concomitant anomalies in the ureter have been noted on two occasions. In Neelsen's[5] case multiple papillomatous tumours grew in the upper end of a bifid ureter, whilst in Jona's[6] case a 'papillary epithelioma' occupied a diverticulum at the lower end of the ureter.

Age and Sex Incidence.—Neoplasms of the ureter, like those situated elsewhere in the urinary tract, occur most frequently late in life, the average age being in the sixth decade for all forms of tumour. Héresco[7] and Thornton[8] recorded the cases of patients 32 years of age, both with benign tumours, at the lower and upper ends of the ureter respectively; whilst, at the other end of the scale, Richter's[9] case was that of a woman, age 80, with a papillary carcinoma 3 cm. above the ureteral orifice. The influence of sex appears to be of little or no importance as an etiological factor. Of 54 patients, 25 were females and 29 were males, a disparity insufficient in extent to draw conclusions from.

PATHOLOGY.

The several varieties of ureteral tumour recorded by different observers suggest the following as a simple pathological classification :—

A. Connective-tissue tumours	Sarcoma.
B. Epithelial tumours	1. Benign papilloma 2. Papillary carcinoma 3. Non-papillary carcinoma.

Sarcoma.—This variety of tumour is extremely rare. I have been able to find records of only 5 cases in the literature. Of these, Targett[10] reported on a male, 45 years of age, in whom the whole of the abdominal portion of the ureter was the seat of tumour growth. Willentzki[11] referred to a sarcoma of the upper ureter, and Ribbert[12] observed a myosarcoma spreading from the renal pelvis into the ureter. It is probable that in all these cases the ureter was invaded secondarily.

Benign Papilloma.—This type of neoplasm appears to be that most commonly met with. It may be sessile or pedunculated, sometimes markedly so. Culver[13] reported a case in which the main tumour consisted of one long villus, 3 cm. in length, growing from a narrow pedicle and projecting distally.

Papillomata may occur singly, as isolated multiple growths, or as a diffuse papillomatosis, affecting a considerable portion of the ureter. Situated anywhere in the ureter, they show a predilection for either the upper or the lower end; sometimes, as in Le Dentu's case, isolated tumours may occupy both these portions. Should they occur at the lower end, they may be extruded through the ureteric orifice, and secondary tumours may be engrafted on the neighbouring vesical wall. In this manner they may simulate the more common multiple papillomata which, having their origin in the renal pelvis, tend to spread down the ureter, either by direct continuity or by the formation of isolated tumours, and eventually involve the vesical mucosa. A typical example of this latter type of tumour is afforded by a case described by Marion,[14] where a total ureterectomy for diffuse papillomatosis was necessitated five years after a nephrectomy for multiple papillomata of the renal pelvis, and where, in the intervening period, frequent fulguration had been required for recurring papillomata situated in the corresponding side of the bladder.

Histologically, ureteral papillomata are similar in every way to those occurring in the renal pelvis or the bladder. Thus they are formed by a branching vascular stroma, surmounted by multiple layers of transitional epithelial cells, sharply delineated from the underlying connective-tissue core. In the connective tissue, especially at the growing margin, are often found groups of small round cells, probably a manifestation of the irritation produced by the advance of the tumour growth.

Papillary Carcinoma.—Papillary tumours of the ureter exhibit a striking tendency towards malignancy. Where a careful histological examination has been carried out on tumours having the macroscopic appearances of benign papillomata, evidences of carcinomatous change have been forthcoming in a number of cases. In some instances the tumour has been found to be exhibiting only early signs of local malignancy, such as increased proliferation of atypical or basal cells with loss of polarity; in others, typical destruction infiltration of the ureteral wall and invasion by tumour-cells of the periureteral tissues have indicated the growth to be essentially carcinomatous. It is important that the whole tumour should be examined, as sometimes only a small portion may show malignant characteristics, the remainder appearing benign. In Richter's case, a localized papillary tumour in the lower third of the right ureter had, in the main, the usual structure of a benign papilloma, except for some variation in type of the epithelial elements. In the central section of the growth, however, tumour tissue in alveolar structure penetrated the muscularis into the connective-tissue sheath, and an infiltrated retroperitoneal gland was found at the autopsy. Almost without exception this type of tumour has formed a single growth and has been situated in the lower portion of the ureter.

Non-papillary Carcinoma.—This group comprises the rarest forms of epithelial tumours found in the ureter. Most have been described as medullary or encephaloid, but there are five cases on record of squamous-celled carcinomata. Amongst the latter is Aschner's case, already referred to, in which leukoplakia featured. As is to be expected with so malignant a form of tumour, early extension to surrounding structures has been manifest.

Thus, in Davy's case a mass involving the base of the bladder, and ulcerating into the rectum, had originated in an encephaloid carcinoma of the lower end of the ureter. In Hektoen's[15] case a medullary carcinoma eroded the right iliac bone, and grew to form a mass in the right inguinal region, thereby justifying the clinical diagnosis of osteosarcoma.

Effects upon the Proximal Ureter and Renal Pelvis.—Practically all ureteral growths tend sooner or later to produce mechanical obstruction, with the result that the proximal portion of the ureter and the renal pelvis dilate. Secondary hydronephrosis is therefore a common concomitant lesion, and may be extreme if the obstruction is of gradual onset and long standing, as occasioned by the more benign forms of tumour.

Metastases.—All forms of malignant tumours are noteworthy for the early metastatic formations occasioned by them in distant organs. Spread may be either by way of the blood-stream, or by lymphatics to the retroperitoneal lymphatic glands. The liver was found to be the seat of carcinomatous deposits by Voelcker[16] in a case of papillary carcinoma of the lower left ureter; and by Davy, Schmitt,[17] Rundle,[18] and Vorpahl[19] in cases of non-papillary carcinoma. In Rundle and Vorpahl's patients the lungs were also invaded. Spinal metastases were noted in two cases; in Adler's[20] the 4th lumbar vertebra was involved. Gerstein[21] found a small carcinomatous nodule in the right kidney, which he considered secondary on account of an old-standing hydronephrosis and a relatively large carcinoma at the lower end of the corresponding ureter.

SYMPTOMATOLOGY.

Ureteral tumours possess no pathognomonic symptoms, and thus may simulate such other conditions as renal or vesical tumours, renal calculus, hydronephrosis, or so-called essential hæmaturia.

Hæmaturia.—Undoubtedly the commonest symptom is hæmaturia, which is usually the initial sign and may be the only one present throughout the disease. It has been observed in 65 per cent of all cases, and in over 75 per cent of papillomata and papillary carcinomata. The hæmorrhage is usually intermittent, and may be profuse even from a small growth, thus producing a severe degree of secondary anæmia. In a case described by Hofmann[22] the bleeding occasioned by a papilloma the size of a bean was sufficiently copious to cause the death of the patient. As in renal neoplasms, the blood is intimately mixed with the urine, but clots are liable to form, and their passage may excite a typical ureteral colic. Such clots are usually worm-shaped, and portions of them may be so firm as to be mistaken for calculi by the patient, as occurred in Judd and Struthers'[23] case.

Pain.—Pain is a less common symptom. For convenience it may be divided into three main types which, of course, may merge into one another: (1) Acute colic from the passage of clots; (2) A more constant ache in the loin from backward pressure and dilatation of the renal pelvis; (3) Severe and sometimes lancinating pain from the pressure on important surrounding structures of an infiltrating malignant growth. The presence of a calculus in association with the tumour may be the cause of varying degrees of pain,

quite apart from that occasioned by the tumour itself. Severe pain of unusual origin was observed in Héresco's case, where a male, 32 years of age, with a benign papilloma at the lower end of the ureter, had suffered for ten years from occasional attacks of renal colic on the same side as the lesion, accompanied by phosphaturia. Occasional subsidiary symptoms, such as slight twingeing pains on the affected side and frequency of micturition, may be explained possibly by the irritation and reaction occasioned by the presence of the tumour, or on the other hand may be due to a coincident urinary infection.

Hydronephrosis.—As an objective symptom, hydronephrosis, in varying degree, has been observed in approximately 55 per cent of cases; and in a small proportion, indeed, it has been the sole evidence present of urinary disease. In 1921 Thomson-Walker[24] reported such a case where the diagnosis of diffuse papillomatosis of the ureter was arrived at during an operation for an otherwise symptomless hydronephrosis of eight months' duration in a man who had experienced one attack of hæmaturia four years previously.

It is extremely exceptional that the actual tumour can be palpated or seen externally, apart from where it produces profuse infiltration and local extension. Quinby,[25] however, described the case of a patient where a ureteral tumour was felt as a distinct mass, oval in shape, and situated a little below and to the left of the umbilicus. This tumour was reported on as a mesothelioma of renal *anlage* origin, showing local invasion.

DIAGNOSIS.

As ureteral tumours may simulate in their symptomatology many other lesions of the urinary tract, diagnosis must rest to a large extent upon the data obtained from a complete urological investigation. Cystoscopy and ureteral catheterization should be combined with a routine radiological examination and pyelo-ureterography, whilst the urine obtained from the bladder and separately from the kidneys should be examined bacteriologically, cytologically, and chemically.

The difficulties of diagnosis may be gauged to some extent from the fact that in nearly 40 per cent of the recorded cases the tumour was discovered post mortem. In several of the clinical cases the correct diagnosis has been arrived at only after one or more previous operations on the kidney, undertaken on the assumption that there was present a tumour or simple hydronephrosis of that organ.

Under two conditions diagnosis may be fairly simple. The first is where a tumour is seen actually projecting from the mouth of the ureter. The second is where bleeding continues after the extirpation of a tumour at or near the ureteral orifice, and on cystoscopic examination blood is seen issuing from that aperture. In the latter case, ureteral catheterization will frequently determine the location of the tumour which is causing the bleeding. In either case, however, it may be impossible to identify the upper limit of the growth, or to ascertain whether the tumour is primarily ureteral or originating in the renal pelvis. The first correct pre-operative diagnosis was probably

made in 1899 by Albarran, in a patient upon whom Le Dentu had previously performed a nephrotomy for renal colic. As the urinary fistula continued to discharge, and as the ureter was found to be obstructed from above, Albarran carried out a cystoscopic examination, discovered a papilloma projecting from the ureteral orifice, and demonstrated the ureteral obstruction at a distance of 5 mm. by means of a catheter.

Where the tumour is situated some distance above the ureteric orifice, accurate diagnosis may be extremely difficult. The cystoscopic findings in such cases may be entirely negative, or blood may be seen emanating from the ureter in jets, as an almost continuous stream, or as a solid cylindrical coagulum. Occasionally the ureteral orifice itself is slightly deformed or shows blood-staining of the mucosa surrounding it. Kraft[26] observed during cystoscopy that direct abdominal pressure over the site of a vascular tumour caused a stream of bright blood to be ejected from the ureter, where before the efflux had been clear even though pressure had been exerted over the kidney above. Renal function as tested by excretion of indigo-carmine has been found to be impaired or lost in some cases, whereas in others it has been equal to that of the healthy side, indicating that the tumour has not caused marked obstruction to the urinary outflow.

Ureteral catheterization may give valuable information in various ways. Where blood is issuing from a ureter, the catheter may be suddenly arrested by a definite obstruction, and if, as was pointed out by Marion, the catheter can be introduced beyond this level, clear urine may be obtained, or hæmato-nephrosis, due to central bleeding, may be tapped. Beer[27] obtained no excretion of dye from one side, but a continuous flow of blood occurred after the withdrawal of the catheter, which had been arrested half-way up the ureter. Chiari[28] likewise found an absence of secretion associated with a ureteral obstruction, which bled on impact with the catheter. It is, of course, not uncommon even in a healthy ureter for the tip of a catheter to be arrested in its ascent by a fold of mucous membrane, and also for it to cause traumatic bleeding. Such bleeding, however, is not copious, and there is generally a gradual increase in amount from the moment of its inception, the secretion being clear up to that point. Other sources of ureteral obstruction and possibly of bleeding might be cited, such as simple or tuberculous stricture, calculus, and stenosis of extra-ureteric origin, the last perhaps being most frequently occasioned by the presence of calcified retroperitoneal glands causing pressure on or kinking of the ureter. Any of these conditions may simulate a tumour, and it is therefore very important that the ureteral catheter be made opaque to X rays, and after its introduction a radiogram be taken. In this way the exact site of any form of obstruction can be located, the relationship of the catheter to abnormal shadows ascertained, and the differential diagnosis facilitated.

Pyelo-ureterography has been employed in a small number of the published cases. It is obvious that this method of diagnosis is especially indicated in ureteral tumours, and interesting results have accrued from its use. Thus Quinby found " a definite distortion and obstruction in the ureter, which was curved upward, slightly dilated, and the shadow ended in an abrupt tip opposite the iliac crest ". The ureterogram in Kretschmer's[29] case demonstrated

a distorted ureter, which ascended in an S-shaped curve and terminated with its tip overlying the mid-point of the iliac crest. Culver's case was one in which the kidney had been removed previously on account of the patient experiencing repeated hæmorrhages. As the bleeding recurred, ureterography was carried out, but in this instance the ureterogram failed to show any tortuosity, dilatation, or filling defect, and it extended above the site of the tumour, which was an attenuated papilloma not causing ureteral obstruction.

Occasionally the cytological examination of the urine gives valuable information. Thus Richter found atypical epithelial cells in his case, and Kraft discovered definite detached papillomatous villi. Needless to say, the mere finding of transitional epithelium, even in considerable amount, is of no import. Similarly the presence of pus-cells and organisms does not negative tumour, superimposed infection being not uncommon.

TREATMENT.

The surgical treatment of ureteral tumours depends upon their pathology, upon their site and extent, and upon the general condition of the patient. In those who are poor surgical risks from old age, excessive hæmorrhage, or other grave complications, modifications will be found necessary in the operative technique employed.

In most cases the ideal treatment is complete nephro-ureterectomy, carried out in either one or two stages. Where the growth involves the ureteral orifice or surrounding bladder wall, a partial cystectomy may require to be added, though satisfactory results have been obtained from fulguration of the vesical extension prior to the major operation. Such a drastic form of treatment is indicated on three main grounds: (1) The kidney is generally hydronephrotic, otherwise diseased, or will become functionless as a result of the operation. (2) It is frequently difficult to gauge the exact extent of the tumour; widespread extensions along the ureter may occur, either in continuity or separated by considerable areas of healthy mucosa. (3) Although apparently benign, these tumours may be actually malignant or in a state of incipient malignancy. The complete operation was first performed by Albarran and Le Dentu in 1899.

If a single tumour involves the upper portion of the ureter, and if it has been established previously that the remainder of the ureter is healthy, then nephrectomy and ureterectomy to a point well below the growth is justified. Such patients should report at regular intervals afterwards for examination.

In those tumours of the lower end of the ureter which project into the bladder as pedunculated papillomata, endoscopic fulguration or local excision with re-implantation of the ureteral stump into the bladder may, in certain cases, be the method of choice. The latter form of treatment was first employed in 1899 by Léonté,[30] as reported by Héresco, and subsequently by Albarran,[31] Brunet,[32] Mackenroth,[33] and Finsterer.[34] In each case recovery ensued, but in the first mentioned an acute pyelonephritis followed the operation and necessitated a nephrectomy.

Marion[35] records two cases treated by endoscopic fulguration. In the first a vesical papilloma in the region of the right ureter was so treated in a female

of 66 years. Hæmorrhage recurred, and a tumour situated 5 cm. above the ureteral orifice was similarly dealt with, a successful result being obtained. In his other case a second tumour was likewise situated 5 cm. above the lower end of the ureter, and clear urine was evacuated by means of a ureteral catheter passed beyond it. Following upon fulguration, however, a condition of hæmatonephrosis developed, a nephrectomy was performed, and the cause of the bleeding was discovered to be a series of multiple papillomata in the renal pelvis.

It is evident that operative measures directed only towards papillary tumours at the lower end of the ureter tend to be incomplete. They do not take into account the condition of the kidney and ureter above, which may well be the site of a primary growth. These forms of treatment should be undertaken therefore only in the case of those who are bad surgical risks, as the first step in a deliberate two-stage operation, or on the understanding that further operative interference may be required at a future date.

SUMMARY.

1. Primary tumours of the ureter are rare, and are met with chiefly in the sixth decade of life.

2. Calculus is not a common predisposing factor; when present it is generally associated with malignant forms of tumour.

3. Pathologically these tumours are most frequently papillary in type and many show the structure of benign papillomata, in which case they may be multiple or diffuse. There is a decided tendency towards malignancy—papillary carcinomata, medullary carcinomata, and squamous epitheliomata occur. Sarcomata are excessively rare.

4. Any portion of the ureter may be involved, although there is evidently a predilection towards either the upper or the lower extremity.

5. The symptoms produced are not pathognomonic of the disease, and are the same as those engendered by renal neoplasms—namely, hæmaturia, pain, and sometimes renal enlargement due to the tumour obstructing the ureter and causing hydronephrosis.

6. Accurate diagnosis is usually very difficult, but considerable aid is obtained from the employment of ureteral catheterization and pyelo-ureterography. It is important to locate the downward extent of the tumour, with special reference to the possibility of multiple growths.

7. Radical operation is indicated in treatment. In most instances, nephro-ureterectomy, either complete or partial, is the method of choice. Fulguration of tumours situated at the lower end of the ureter has given encouraging results in patients unsuited for the more radical surgical measures.

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SUBPHRENIC ABSCESS.*

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This condition was described by Barlow as long ago as 1845, and about 1873–4 Hilton Fagge published a paper on "Abscess within the Upper Part of the Abdomen". The first operation for subphrenic abscess, however, was recorded by von Volkmann in 1879. Thenceforth numerous additions to the literature were made in England, America, Germany, and Italy, and in 1908 Barnard's comprehensive paper appeared. It was based on a study of 76 cases at the London Hospital, and contained, among other things, a very complete description for practical purposes of the anatomical boundaries of the subphrenic spaces. It is essential to be able to visualize these if the causes and sequelæ of subphrenic suppuration are to be clearly understood and correct treatment is to be instituted.

ANATOMY AND ETIOLOGY.

The abdominal surface of the diaphragm (*Fig.* 434) is covered by peritoneum except in one place, where it is in contact with the 'bare area' of the liver (in reality it is separated from this by cellular tissue). This is known as the *right extraperitoneal subphrenic space*, and is bounded anteriorly by the right lobe of the liver and right suprarenal body, posteriorly by the diaphragm, to the left by the inferior vena cava and right crus of the diaphragm, above by the anterior layer of the coronary ligament, below by the posterior layer, and to the right by the meeting of these two layers to form the right lateral ligament. Anteriorly its cellular tissue is continuous over the top of the liver with that in the falciform ligament, inferiorly with that behind the ascending colon and right lumbar fossa, and to the right with that in the right lateral ligament, whilst it is continuous round the arcuate ligaments with the cellular tissue in the thorax.

The formation of an abscess in this space has resulted from infection from the liver and biliary passages; from the abdominal wall by way of the lymphatics round the epigastric vessels, which are continuous with those in the falciform ligament; from the right retroperitoneal tissue following perforation of a posterior duodenal ulcer, retrocæcal appendicitis, ulceration of the ascending colon and hepatic flexure, a high perinephric abscess, and pancreatic suppuration; and from supradiaphragmatic conditions such as empyema, bronchiectasis, and abscess of the lung.

In the present series of cases there were 20 right extraperitoneal subdiaphragmatic abscesses, of which 12 followed appendicitis, 1 perforation of a duodenal ulcer, 1 tuberculous periosteomyelitis of a rib, 2 pyonephrosis (1 being calculous in origin, the other tuberculous), and 4 were of doubtful origin.

* Based upon 78 consecutive cases occurring at the London Hospital.

There is a tendency for suppuration in this space to spread forward over the top of the liver between the two layers of the falciform ligament, and for an abscess to form in the epigastrium. This happened in 2 of the present series of cases, an abscess forming and being opened a little below the ensiform process. This sequel suggests that when a right extraperitoneal abscess is suspected the epigastrium should be carefully palpated. If fullness be detected, the possibility of anterior drainage between the two layers of the falciform ligament should be carefully considered, which, if practicable, might obviate transpleural drainage.

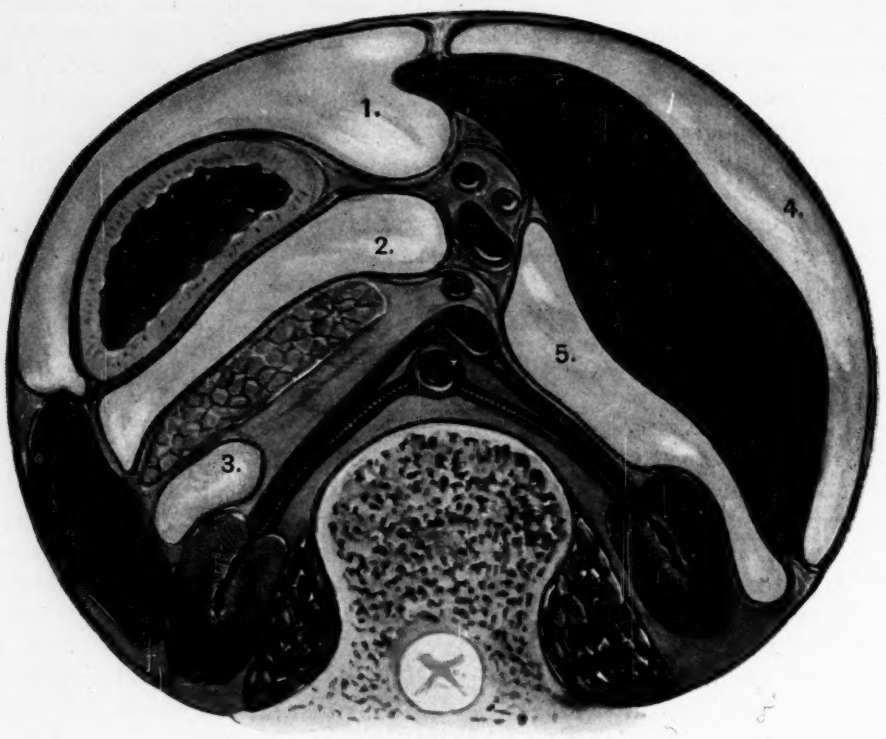

FIG. 434.—Diagram showing anatomical relationships of five types of subphrenic abscess. 1, Left anterior intraperitoneal; 2, Left posterior intraperitoneal; 3, Left extraperitoneal; 4, Right anterior intraperitoneal; 5, Right posterior intraperitoneal.

Anatomically the *left extraperitoneal subphrenic space* does not exist. When a left extraperitoneal abscess forms, it commences round the upper pole of the left kidney and extends upwards, stripping the peritoneum off the diaphragm. It is then bounded above by the diaphragm; behind by the upper part of the left kidney and suprarenal; anteriorly by the end of the œsophagus, the bare area of the stomach, and below this by the lesser sac, pancreas, and spleen; to the left by the diaphragm; and to the right by the aorta and vertebral column. A left extraperitoneal abscess has resulted from perforation of a posterior gastric ulcer, the lesser sac having been obliterated by adhesions (Barnard, Mayo Robson); left retroperitoneal inflammation,

including a high perinephric abscess, ulceration of the colon, diverticulitis, acute periosteomyelitis of lumbar vertebræ, perforation of a carcinoma of the lower end of the œsophagus; and supradiaphragmatic conditions mentioned previously.

In the present series of cases there was only 1 left extraperitoneal abscess, and this resulted from perforation of a carcinoma of the lower end of the œsophagus.

In front and above the right extraperitoneal space is the *right anterior intraperitoneal subphrenic space.* This lies between the superior, anterior, and right lateral surfaces of the right lobe of the liver and the corresponding part of the diaphragm. It is limited posteriorly by the anterior layer of the coronary ligament and the right lateral ligament, to the left by the falciform ligament, and is continuous with the right posterior intraperitoneal space round the border of the right lateral ligament and the margin of the liver. It also freely communicates with the paracolic groove or right lumbar fossa lying to the outer side of the ascending colon; this groove communicates with the pelvis round the outer side of the cæcum. When an abscess forms in the right anterior subphrenic pouch, it is generally limited below by adhesions between the transverse colon, great omentum, and abdominal wall. If, however, it results from a paracæcal appendicitis or from hepatic suppuration, the anterior border of the liver becomes adherent to the diaphragm and abdominal wall, the lower boundary being thus formed. Right anterior subphrenic abscess has resulted from appendicitis, rupture of a duodenal ulcer or gastric ulcer, and suppuration in the liver and biliary passages.

In the present series of cases this subphrenic space was involved 13 times, 6 following appendicitis, 3 perforation of a duodenal ulcer, 2 perforation of a gastric ulcer, and 2 were doubtful.

Below the right extraperitoneal space, and somewhat anterior to it, is the *right posterior intraperitoneal subphrenic space.* This is often described as Cantlie's subhepatic pouch or Rutherford Morison's kidney pouch. It is pyramidal in shape, and lies transversely beneath the right lobe of the liver. To the right its base is in contact with the right lobe of the liver and the diaphragm, projecting below this somewhat so that it can be reached by an incision below the 12th rib. To the left its apex is situated at the foramen of Winslow, and below this it is bounded medially by the duodenum. Anteriorly are the liver and gall-bladder; posteriorly the upper half of the right kidney and diaphragm; superiorly the liver, posterior layer of the coronary ligament, and the right lateral ligament; and inferiorly the transverse colon and hepatic flexure. It communicates with the right anterior subphrenic space round the right lateral ligament and margin of the liver, with the right lumbar or paracolic groove round the outer side of the hepatic flexure, and with the lesser sac through the foramen of Winslow.

When an abscess is present, it is separated from the left anterior subphrenic space by adhesions between the left lobe of the liver and the anterior surface of the stomach, and it is separated from the general peritoneal cavity by adhesions between the margin of the right lobe of the liver, abdominal wall, transverse colon, and great omentum. The foramen of Winslow is generally closed by adhesions.

Subhepatic abscess follows appendicitis, perforation of a duodenal or gastric ulcer, hepatic or biliary suppuration, operations on the gall-bladder and ducts, duodenum, and stomach, and suppuration above the diaphragm.

In the present series of cases there were 29 subhepatic abscesses, of which 12 resulted from appendicitis, 5 perforation of a duodenal ulcer, 3 acute cholecystitis, 1 perforation of the common duct by a gall-stone, 3 perforation of a gastric ulcer, 1 a gastric operation, 1 a fractured pelvis, and 3 were of doubtful origin. The sequence of events which led to the formation of an abscess after a fracture of the pelvis was as follows: At the time of fracture the membranous urethra was torn; this led to the formation of a peri-urethral abscess, followed by an abscess in the cave of Retzius and one in the right iliac fossa. Retroperitoneal inflammation (cellulitis and lymphangitis) spread upwards behind the ascending colon, and, contrary to what one would have expected (i.e., the formation of a right extraperitoneal abscess), led to the formation of a right posterior intraperitoneal abscess.

The *left anterior intraperitoneal space* is bounded above by the diaphragm; behind by the left lateral ligament and lobe of the liver, gastrohepatic omentum, and the anterior surface of the stomach; below by the adhesion of the stomach or great omentum to the anterior abdominal wall or diaphragm; to the right by the falciform ligament; to the left by the spleen and gastro-splenic omentum and the diaphragm; and anteriorly by the diaphragm and anterior abdominal wall. It communicates to the right with the subhepatic pouch beneath the postero-inferior border of the falciform ligament in front of the pylorus. To the left it leads in front of the phrenico-colic ligament (or sustentaculum lienis) to the left paracolic or lumbar groove, and hence to the pelvis along the outer side of the iliac colon. Immediately to the inner side, and just in front of the splenic flexure, it communicates with a groove between the vertebral column and the descending colon which also leads down to the pelvis.

An abscess in the left anterior subphrenic space is sometimes described as perigastric or perisplenic, and has resulted from perforation of a gastric or duodenal ulcer or carcinoma, abscess of spleen, hepatic suppuration, or pelvic suppuration spreading upwards along the left internal or external lumbar fossa. It may also follow partial gastrectomy or colectomy.

In the present series of cases there were 14 left anterior intraperitoneal subphrenic abscesses; 8 followed operations on the stomach, 3 perforation of gastric ulcer, 2 perforation of duodenal ulcer, and 1 cancer of the stomach.

The *left posterior intraperitoneal subphrenic space* is the lesser sac. It is bounded posteriorly from above downwards by the diaphragm, pancreas, transverse mesocolon, transverse colon, and the two posterior layers of the great omentum; and anteriorly by the spigelian lobe of the liver, gastro-hepatic omentum (lesser omentum), stomach, and two anterior layers of the great omentum. To the left it is limited by the lieno-renal ligament, spleen and gastrosplenic omentum, and the meeting of the layers of the great omentum; to the right by the meeting of the layers of the great omentum, and by the proximal third of the first part of the duodenum, above which is the foramen of Winslow, through which the lesser communicates with the greater sac, i.e., the right posterior intraperitoneal space.

An abscess of the lesser sac may result from perforation of a posterior gastric ulcer or rarely a duodenal ulcer, pancreatitis, infection of a pseudo-cyst of the pancreas, and splenic or hepatic suppuration.

In the present series of cases there were 7 abscesses of the lesser sac; 4 resulted from perforation of a posterior gastric ulcer, and 1 chronic perforation or 'leaking' of a gastric ulcer; 1 followed perforation of an ulcer on the posterior wall of the proximal third of the first part of the duodenum (which is a right anterior boundary of the lesser sac), and 1 resulted from acute cholecystitis, being associated with a right posterior intraperitoneal abscess.

Etiology.—*Appendicitis* may lead to the formation of a subphrenic abscess in the following ways (***Fig.* 435**):—

1. If the appendix is paracæcal in position, inflammation may spread up the right lumbar fossa to the outer surface of the liver and so to the right anterior subphrenic space; or the inflammation on reaching the lower border of the liver may pass round the hepatic flexure into the subhepatic pouch, from which rarely it may spread to the lesser sac by way of the foramen of Winslow, which, however, is usually closed by adhesions before this can occur.

2. When the appendix is retrocæcal in position, inflammation may spread up behind the ascending colon (i.e., an ascending retroperitoneal cellulitis) to the right extraperitoneal subphrenic space.

3. Should the appendix be in the splenic position, i.e., lying behind the lower end of the ileum and mesentery, inflammation may spread by way of the left internal lumbar fossa to the left anterior subphrenic space.

4. A pelvic appendix abscess may extend by way of the left internal or external lumbar fossa to the left anterior subphrenic space.

FIG. 435. — Diagram showing paths of infection to the subphrenic spaces following acute appendicitis. 1, 2, Right anterior and posterior intraperitoneal respectively (along paracolic groove); 3, Right extraperitoneal (along extraperitoneal cellular tissue).

5. Appendicitis in any position may be followed by pylephlebitis, and the hepatic suppuration lead to the formation of subphrenic abscesses.

In the present series appendicitis was the cause of 30 subphrenic abscesses —12 right extraperitoneal, 12 right posterior intraperitoneal, and 6 right anterior intraperitoneal.

A *gastric ulcer* may perforate and result in the formation of a subphrenic abscess. The perforation is generally on the anterior surface of the stomach, the left anterior intraperitoneal subphrenic space being infected. If a posterior ulcer rupture, an abscess of the lesser sac may follow; this space, however,

is often shut off by adhesions, so that the rupture occurs into the cellular tissue round the upper pole of the left kidney, a left extraperitoneal abscess resulting (Mayo Robson, Barnard). Occasionally perforation of a gastric ulcer may lead to a right-sided intraperitoneal subphrenic abscess.

In the present series perforation of a gastric ulcer was the origin of 12 subphrenic abscesses, of which 4 were left posterior intraperitoneal, 3 left anterior intraperitoneal, 3 right posterior intraperitoneal, 2 right anterior intraperitoneal.

Perforation of a *duodenal ulcer* usually produces an abscess in the subhepatic pouch, and not infrequently in the right anterior intraperitoneal space; but perforation posteriorly may lead to a right extraperitoneal subphrenic abscess. The left anterior subphrenic space and the lesser sac may be infected as a result of duodenal perforation.

In the present series subphrenic abscess followed 12 cases of perforated duodenal ulcer, and of these abscesses 5 were right posterior intraperitoneal, 3 right anterior intraperitoneal, 2 left anterior intraperitoneal, 1 was left posterior intraperitoneal, and 1 right extraperitoneal.

Hepatic suppuration may be followed by any type of subphrenic abscess, but usually by right extraperitoneal or right anterior intraperitoneal. In this series there was no example of a subphrenic abscess resulting from this cause.

Suppuration in the biliary passages may lead to the formation of a subphrenic abscess. In the present series acute cholecystitis was followed by subhepatic abscess in 3 cases, 1 of which was accompanied by an abscess of the lesser sac; perforation of the common bile-duct by a gall-stone led to the formation of a subhepatic abscess.

CAUSES AND VARIETIES OF SUBPHRENIC ABSCESSES.

CAUSE	RIGHT EXTRAPERITONEAL	RIGHT ANTERIOR	RIGHT POSTERIOR	LEFT ANTERIOR	LEFT POSTERIOR	LEFT EXTRAPERITONEAL
Appendix	12	6	12	—	—	—
Gall-bladder	—	—	4	—	1	—
Operations on stomach	—	—	1	8	—	—
Perforated duodenal ulcer	1	3	5	2	1	—
Perforated gastric ulcer ..	—	2	3	3	4	—
Chronic gastric ulcer ..	—	—	—	—	1	—
Carcinoma of stomach ..	—	—	—	1	—	—
Carcinoma of œsophagus	—	—	—	—	—	1
Kidney	2	—	—	—	—	—
Fractured pelvis ..	—	—	1	—	—	—
Rib	1	—	—	—	—	—
Unknown	4	2	3	—	—	—
Totals ..	20	13	29	14	7	1

AGE AND SEX INCIDENCE.—

Age (years)	0–10	11–20	21–30	31–40	41–50	51–60	61–70
Cases ..	6	15	19	17	13	6	2

Total .. 78 (43 males, 35 females).

PATHOLOGY.

Infection of the subphrenic space may result from :—

1. Wounds.

2. Gravitation of inflammatory exudate from general or local peritonitis or of extravasated contents of a viscus (spontaneous or operative).

3. Hæmatogenous infection.

4. Direct extension from a neighbouring viscus—e.g., rupture of a liver abscess into the right extraperitoneal space.

5. Lymphatic spread :—

a. The retroperitoneal lymphatics.

b. The diaphragmatic lymphatics. There are supra- and infra-diaphragmatic plexuses intercommunicating freely. If there be pus under pressure above the diaphragm, infection may spread through to the subphrenic spaces, but the extension of infection in the opposite direction is a very much more frequent occurrence.

c. The lymphatics along the deep and superior epigastric vessels communicate with those in the falciform ligament.

In connection with (2) it is necessary to consider briefly the *abdominal watersheds*. The posterior abdominal wall presents certain well-marked watersheds : the median longitudinal, formed by the vertebral column ; and the transverse, formed by the forward convexity of the lumbar curve, and on each side of this the kidney in its perinephric fat and the thick muscles of the loin. Fluid tends to collect in the subphrenic spaces above and the pelvis below ; if the patient be tilted sufficiently (i.e., placed in Fowler's position), it will flow from the former over the transverse watershed round the outer side of the cæcum and iliac colon into the pelvis, where it is much less rapidly absorbed and more easily treated.

The relationship of the pylorus and first part of the duodenum to the median watershed is of much interest. Generally they lie to the right of it, so that right-sided subphrenic abscesses may follow perforation of them. If they lie to the left, left-sided abscesses may result. This was the explanation given by Box of the cases he reported, and it certainly seems satisfactory. Rolleston, in a similar type of case to those of Box, thought that previously-formed adhesions were the main factor in determining the direction of the flow of extravasated material to the left side.

Extraperitoneal subphrenic abscess is an example of cellulitis terminating in suppuration.

Intraperitoneal subphrenic abscess is an end-result of acute localized peritonitis. Inflammatory exudate is poured out, and after ten to fourteen days a localized abscess is present, walled in by fibrin and, later, granulation tissue. The abscess may be uni- or multilocular, and not infrequently two spaces are involved at the same time. In the present series of cases there were 6 examples of this. On two occasions both the right anterior and posterior subphrenic intraperitoneal spaces were involved at the same time following perforation of a duodenal ulcer ; in another case involvement of the right anterior intra- and right extra-peritoneal spaces resulted from perforation

of a duodenal ulcer; perforation of a gastric ulcer led to the formation of left and right anterior subphrenic abscesses; purulent cholecystitis with portal pyæmia resulted in left and right posterior intraperitoneal abscesses; and perforation of a gastric ulcer was followed by left anterior and right posterior intraperitoneal abscesses.

The abscess often contains gas, which may have escaped from a perforated viscus or been formed by organisms, e.g., the *Bacillus coli communis*. Fluid present is mainly purulent exudate, the result of bacterial and chemical irritation, but it may also contain gastric and duodenal contents, bile, liver-cells, echinococcal cysts, etc.

As the abscess enlarges, the diaphragm is pushed upwards, obliterating the costophrenic space, which not infrequently becomes closed by adhesions; clear fluid, often in large amount, collects in the pleural cavity, and empyema may follow. The lung is pushed upwards and may be collapsed. In the absence of adhesions, depression of the abdominal viscera may result, especially in the case of extraperitoneal abscess.

Many different kinds of organisms may give rise to subphrenic suppuration; but those most commonly present include the *Bacillus coli communis*, streptococci, staphylococci, etc., as shown in the table below. Tubercle bacilli and actinomyces have been demonstrated. In the present series the pus was examined in 30 cases, with the following results :—

Sterile :—Acute cholecystitis	.. ..	2	
Tuberculosis of kidney	.. .. ..	1	
Tuberculosis of rib	.. ..	1	
Appendix	.. ..	1	
Perforated gastric ulcer	.. .. ..	1	
Doubtful	.. ..	2	
		—	8
Staphylococci :—Appendix	.. ..	—	4
Streptococci :—Appendix	.. ..	1	
Perforated duodenal ulcer	.. .. ..	1	
		—	2
Pneumococci and *Streptococci* :—Perforated gastric ulcer	..	—	1
B. Coli and *Streptococci* :—Appendix	.. .. ..	—	1
B. Coli :—Appendix	.. ..	2	
Doubtful	.. ..	1	
		—	3
B. Coli and *Staphylococci* :—Appendix	.. .. ..	6	
Perforated gastric ulcer	..	1	
Operation on stomach	..	2	
Doubtful	.. .. ..	1	
		—	10
Friedländer Group :—Appendix	.. ..	—	1

Relative Frequency of Organisms :—*B. coli*	.. ..	14
Staphylococci	..	14
Streptococci	..	4
Pneumococci	..	1
Friedländer group	..	1
Sterile	.. ..	8

From a consideration of the anatomy, previously described, of subphrenic abscess, it will be seen that *rupture* may occur into the pleura, lung (and bronchus), pericardium, œsophagus, general peritoneal cavity, and externally. In the present series of cases 5 perforated the diaphragm into the lung (or bronchus), 4 into the pleural cavity only (producing empyema), 1 into the

gall-bladder, 2 into the hepatic flexure of the colon, and one penetrated into the spleen. In no case did rupture into the general peritoneal cavity occur.

Although gastric and duodenal fistulæ may follow a subphrenic abscess, they are distinctly uncommon, and no example of this sequela is to be found in the present series.

DIAGNOSIS.

It has always been recognized that the diagnosis of this condition is occasionally very difficult, as is indicated by the fact that out of this series of 78 cases only 59 were subjected to operation, leaving a residue of 19. A few of these were not suitable for operation owing to the condition of the patient or the nature of the primary lesion; but the majority might have been given the benefit of surgical treatment had the presence of a subphrenic abscess been suspected and the pus sought.

In obscure abdominal cases where symptoms of infection are present it is well to bear in mind the aphorism "Pus somewhere, pus nowhere else, therefore pus under diaphragm"; and many cases are diagnosed only by the exclusion of pus elsewhere and exploration of the subdiaphragmatic spaces.

The history is in most cases suggestive. A typical case is one in which an infective focus in the abdominal cavity has been dealt with, and the condition of the patient temporarily improves, after which the signs and symptoms of toxæmia reappear. The quiescent interval may be as long as four months, as occurred after a case of appendicitis in this series, during which period the patient was at work; but more commonly the primary lesion almost merges into the period during which the subdiaphragmatic infection dominates the clinical picture. As with liver abscesses, the rapid absorption of pus produces marked features of toxæmia; hence irregular temperature, sweating, wasting, and anæmia are frequently in evidence, which arouses the suspicion of some obscure focus of infection. Furthermore, the patient may complain of fullness, pain in the upper abdomen, or omalgia.

Physical Examination.—Inspection of the chest and abdomen may reveal local abdominal swelling, bulging of the ribs, or immobility of the chest. In 21 of our series of cases a swelling was palpable in the abdomen or loin. In a few cases, particularly with right extraperitoneal abscesses, the liver was displaced downwards; but this is by no means constant even with large collections of pus, as adhesions round the liver may fix it in position, in which case signs in the chest are very definite.

Examination of the chest is of extreme importance. In the majority of cases pressure signs at the base of the lung may be recognized; in other cases pleural effusion or empyema are not uncommonly associated conditions. If gas is present in appreciable quantity, then percussion may yield characteristic information in that four zones of altered resonance are present; thus, below, a dull area is found due to the liver; above this the gas gives a tympanic note; then a zone of diminished resonance indicates pressure on the lung with partial collapse; while above, normal lung resonance may be obtained.

In some recorded cases the presence of Grocco's triangle has been noted on the opposite side, and it has disappeared after drainage of the abscess.

Accessory Investigations.—As would be expected, a blood-count usually indicates the presence of pus, provided the patient's resistance is sufficient to stimulate reaction; but the most valuable assistance in localizing the presence of pus is radiographic examination. Out of 37 cases in this series, in which the result of radiographic examinations are recorded, no fewer than 21 were definitely diagnosed, in 9 cases an abscess was suspected, and in the remaining 7 cases no evidence was found. Three abnormalities may be recognized by the screen: (1) Elevation of the diaphragm, which normally on the right side reaches the 5th rib; (2) Diminished mobility, the usual excursion during deep respiration being 1 to 1½ in.; (3) Alteration of contour due to the presence of a local collection of pus. In addition to these features, the presence of gas may give valuable information, as the result in clear areas may be easily detected.

The final court of appeal is the exploring needle, but explorations should always be performed in the theatre, so that drainage may be established at the same time, otherwise infection along the needle track is possible, and subsequent exploration may miss the abscess.

Differential Diagnosis.—Owing to the insidious onset, and frequently obscure physical signs, the differential diagnosis of this condition is sometimes difficult.

Pylephlebitis is frequently due to the same causes as subphrenic abscess, so that the history of these two conditions may be identical. The onset of pylephlebitis, however, is usually abrupt, possibly ushered in by a rigor, and rigors during the course of this disease are common. Hepatic enlargement is generally obvious, but it may be distinguished from the displaced liver sometimes associated with subphrenic abscess in that tenderness is present. Radiographic evidence is valuable, and later, jaundice may occur in cases of pylephlebitis.

Empyema is another condition which closely simulates subphrenic abscess or may be associated with it. The respective histories often indicate which condition is present, and lateral cardiac displacement is typical of fluid in the chest. X-ray appearances, if showing gas or local bulging, may distinguish the two conditions. Frequently the exploring needle must be used, the movement of the needle during respiratory excursions then indicating the subdiaphragmatic site of the abscess.

The physical signs of *liver abscess* so closely simulate subdiaphragmatic infection that distinction may be impossible, although the history of the case or the presence of amœbæ in the stools may be suggestive.

Perinephric infection may cause some confusion in diagnosis; but history, routine examination, and site of swelling should establish a diagnosis.

Among other conditions which have been mistaken for subphrenic abscess are aortic aneurysm, pancreatic cysts, and renal tumour; but the non-inflammatory natures and characteristic features of these conditions should distinguish them.

TREATMENT.

The treatment of subphrenic abscesses is, to a certain extent, *prophylactic*; the adoption of Fowler's position in some cases, and efficient drainage where

a primary infective focus is dealt with, have certainly reduced the incidence. Previous to the general practice of placing the patient in Fowler's position in cases of acute appendicitis with infection, the subsequent formation of a subphrenic abscess was a comparatively common complication; now it is estimated that in only 0·6 per cent to 1 per cent does subphrenic abscess occur. Little can be done to prevent lymphatic infection, but gravity would seem to be of some importance in discouraging pus from tracking upwards towards the diaphragm.

In cases of acute appendicitis the incidence of subphrenic infection is much reduced when the delayed method of treatment is adopted. This treatment gives cases of localized or general peritonitis, i.e., cases in which the appendix is perforated, an opportunity to subside, so that a clean operation may be performed later. In the majority of cases acute symptoms successfully abate and the virulence of the infection subsides as the resistance of the patient increases. Thus, in 228 cases treated on delayed lines at the London Hospital, subphrenic abscess occurred in only one case, whereas in 1109 cases subjected to immediate operation 7 were complicated by subphrenic abscess.

Another point of importance in connection with prophylaxis is the establishment of efficient drainage where such is necessary. Subphrenic abscess appears to be more common in retrocæcal and paracolic appendicitis than when the organ points downwards or towards the left. This is doubtless due to infection along the retroperitoneal cellular tissue, and partly to infection passing along the paracolic groove, and hence drainage by a stab wound in the loin tends to counteract these two modes of infection. During the years 1919–22 no case of subphrenic abscess occurred when drainage was established by this route.

Little can be accomplished in the way of prophylaxis regarding cases of perforated ulcer in the upper abdomen, as the harm has already been done before surgical intervention. However, the careful removal of extravasated visceral contents, the adoption of Fowler's position, and drainage if necessary, mitigate against the formation of an abscess. The almost routine use of a drainage tube after cholecystectomy makes this operation a very uncommon cause of subphrenic infection; in this series the 4 cases connected with gall-bladder lesions were already the subject of gross infection.

Regarding the *actual treatment* of the abscess, the search for pus should always be conducted in the theatre. In cases where a lump can actually be palpated in the loin or abdomen, then incision and drainage are adopted. In the latter cases posterior drainage should be established if possible, by means of a stab wound, in which case the anterior incision may be closed.

When needling is indicated the needle should be inserted through the lower intercostal spaces in the posterior axillary line; failing detection of an abscess, puncture should then be made in the mid-axillary and paravertebral lines. For an adult of average size a 4-inch needle of wide bore is used, as pus may be thick. When pus is found, the respiratory movements of the diaphragm are transmitted to the needle, indicating that the abscess is below the diaphragm.

The rib below the needle is excised subperiosteally for about three inches.

If necessary the parietal pleura is stitched to the diaphragm. As a general rule, adhesions have already formed, but too much reliance must not be placed on their presence. Subsequent collapse of the diaphragm when the support of pus is withdrawn may separate adhesions between it and the parietal pleura, allowing secondary infection of the pleural cavity. Hence, in doubtful cases, and especially at a high level, e.g., the 8th rib, sutures provide an extra safeguard. The diaphragm is then incised across its fibres, a finger introduced, and the drainage tube inserted in the cavity.

PROGNOSIS.

Out of the 78 cases which comprise this series, 39 terminated fatally, with or without operation; that is, exactly 50 per cent. In some of the cases which died before operation doubtless the primary condition was the actual cause of death. Eliminating these, we found that of 59 cases submitted to operation 39 recovered and 20 died, giving a mortality of 32 per cent.

On analysing the results of different operative measures we find as follows:—

Operation	Recovered	Died	Mortality
Drainage through anterior abdominal wall	16	5	23·8
Drainage through loin below 12th rib ..	5	1	16·7
Drainage through pleural cavity ..	18	14	43 7

The above list confirms what one would expect to find, that when the presence of pus can be readily detected and efficient drainage established, then a relatively low mortality may be expected. The high mortality associated with drainage through the chest wall is partly accounted for by delay in searching for the pus, so that the general condition of the patient deteriorates before the abscess is discovered.

CONCLUSIONS.

1. In this series of 78 cases of subphrenic abscesses, appendicitis was the cause in no fewer than 30, the commonest variety being right posterior intraperitoneal, of which there were 29 examples.

2. In cases of acute appendicitis in which the infection has spread beyond the appendix, expectant treatment reduces the incidence of subphrenic infection considerably.

3. In order to obviate pleural infection and obtain dependent drainage, a rib should be resected as low as possible, commonly the 10th. Posterior drainage should be carried out whenever possible; even when an anterior subphrenic space is involved, this can usually be accomplished.

4. The tendency of a right extraperitoneal abscess to extend forward between the layers of the falciform ligament was noticed in two cases, which suggests a possible route for drainage without involvement of the peritoneal or pleural cavities.

We desire to thank the surgical staff of the London Hospital for permission to include in this series cases under their supervision.

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HÆMANGIOMA OF LEG.

By GEORGE BELL and KEITH INGLIS, Sydney.

CLINICAL REPORT (G. B.).

The patient, a female, age 17, was first admitted to Sydney Hospital on May 1, 1922.

When two years old she was kicked on the right leg, and soon afterwards a swelling was noticed. At the age of six years she was operated on by a surgeon, who is said to have restored the leg and foot to a normal size and shape. Radium has been applied to the tumour and caused no improvement. She has ceased to walk on the leg, which is now kept flexed on the thigh, with the foot in the position of talipes equinovarus. The right leg and thigh are wasted. There is a hard swelling in the leg, which extends from just above the ankle to the upper third of the leg posteriorly. The right thigh measured 37 cm. in circumference and the left 40·5 cm.; the right leg 35 cm., and the left 37·5 cm.

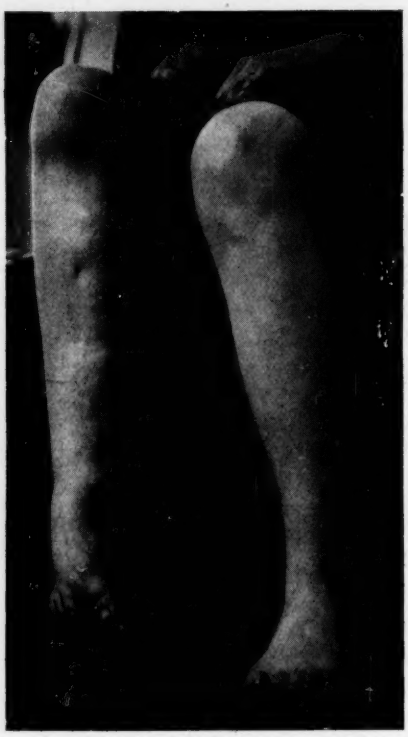

Fig. 436.—Showing the appearance of the limb in August, 1924, immediately before amputation.

In June, 1922, she was seen in consultation with Sir Herbert Maitland, who advised amputation at the knee-joint. The patient was unwilling to have the leg amputated then. On May 3, 1922, the Wassermann reaction was negative. During May, 1922, potassium iodide was administered, and also two doses of 0·3 grm. novarsenobenzol.

On May 29, 1922, under an anæsthetic, a piece of tissue was removed from the lateral portion of the leg at the junction of the middle and lower thirds. Dr. Keith Inglis examined this, and reported that the growth was a hæmangio-fibro-endothelioma.

The patient was again admitted to Sydney Hospital on July 28, 1924. She stated that the leg was usually not painful. Sometimes she felt sharp stabbing pains if she allowed it to hang down. The leg is gradually increasing in size, and the right is always warmer than the left. She had had radium and X rays applied.

On examination, the position of the leg and foot was much the same. The ankle could be flexed slightly, and there was also a slight range of inversion and eversion. The toes also could be moved through a fair range. The length of the right thigh was 37 cm., and that of the left 40·5 cm. The greatest circumference of the right thigh was 35·5 cm., and that of the left 44 cm. The lengths of the right and left legs were 33 cm. and 36 cm. respectively, and the greatest circumferences were 26·5 cm. and 29 cm. (*Fig.* 436). Two pigmented, slightly raised areas were present in the right leg, one over and one immediately below the medial malleolus. There was hyperidrosis of the right leg; the skin temperature of this leg was higher.

On Aug. 6, 1924, I performed a transcondylar amputation of the thigh. This healed by first intention, and the stump when seen during the last week of October, 1924, was an excellent one and showed no signs of recurrence of the growth.

Radiographic examinations were carried out and reports given as follows: (1) May 2, 1922: "Periostitis middle third of fibula; osteoarthritis of knee-joint." (2) July 15, 1924: "There is some periosteal roughening at the level of the tumour." (*Fig.* 437.)

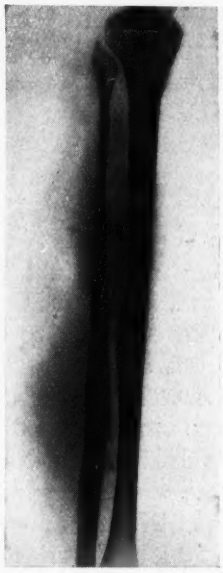

FIG. 437.—Showing the variation in density of the soft parts due to the tumour. The scattered deposits of calcium salts in the tumour can be detected. The effects on the bones are also evident. The maximum effect is just below the middle of the leg.

PATHOLOGICAL REPORT (K. I.).

Within an hour after the limb was amputated an endeavour was made to perfuse it with Kaiserling's solution. All attempts to do this were unsuccessful, because the blood-vessels, even in the proximal end of the amputated limb, were abnormal, and appeared to merge insensibly in the angiomatous tumour. After removing a long slice of tissue from the posterior aspect of the leg it was found that a hæmangioma extended from the ankle almost to the knee (*Fig.* 438). The anatomical structures on the hind part of the leg were abnormal and ill defined, and the muscles were rendered inconspicuous by the extensive fibro-angiomatous tumour. It seemed as if the blood-spaces did not cause atrophy of muscle by pressure, but that the hæmangioma was actually in the substance of what would normally have been muscle. The large vascular sponge which permeated the muscles only slightly affected the adipose tissue and did not involve the skin (*Fig.* 438). It is probable that disuse and pressure were responsible for some of the muscle atrophy, but I am rather inclined to think that the almost complete absence of voluntary muscle on the posterior aspect of the leg was partly due to faulty development.

In order to study the tissues more thoroughly, a block 5 cm. long was cut out of the middle of the leg, where the changes in the bones

were most marked. This block of tissue included a portion of tibia and fibula and much of the soft parts around them. The skiagram of this segment showed the blurred outline of the bones and the bone spicules projecting into the soft parts. Horizontal sections of this segment revealed no definite posterior tibial artery—merely angiomatous tissue extending forward between the bones about as far as the normal situation of the interosseous membrane; but this membrane was not definitely recognized. In the front of the leg the muscles showed no abnormality, and the anterior tibial artery was evident.

Wollard,[1] in studying the development of the principal arterial stems in the forelimb of the pig, found that three stages could be distinguished: (1) The stage of the capillary net; (2) The stage characterized by large tubes showing island formation, coalescence, and a tendency to fuse—the retiform stage; and (3) The formation of a definite stem. I suggest that in our patient the small radicles forming the original net have in some areas failed to fuse, and, without fusing, have later become enlarged, dilated, and tortuous, to form a tumour in which both arteries and veins are represented. This would account for the absence of the posterior tibial artery by assuming, not that it had disappeared, but that it had never developed, and it would also explain the vascular sponge replacing the voluntary muscle.

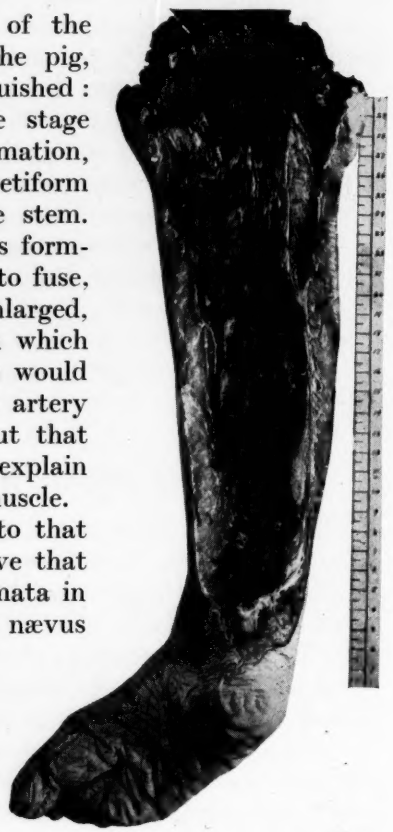

FIG. 438.—Showing the leg after removing a long thin piece of the soft parts from the dorsal aspect (centimetre scale).

The mode of extension is probably akin to that of nævi described by John Duncan.[2] I believe that what Duncan says of nævi holds true of angiomata in general. There are two modes by which a nævus may increase in bulk, he states, the intrinsic and the extrinsic. It may grow by the invasion of surrounding parts, or by pushing them aside through addition to its own internal bulk. Many a nævus runs a course which entirely precludes the idea of its increase being otherwise than by involving the surrounding tissues in its own mode of growth.

Microscopically the tumour in our patient is made up mainly of blood spaces of various sizes and shapes and filled with what appears to be normal blood. Some spaces contain granular material which is pink in preparations stained by hæmatoxylin and eosin. This is probably lymph. The presence of spaces containing lymph is deserving of comment. In many angiomata both blood spaces and lymph spaces are to be seen. It is true that in most angiomata one of the two predominates sometimes almost to the exclusion of the other, and in the present case it is the hæmangiomatous element which is by far the more conspicuous—so much so that by the naked eye the lymphangiomatous element cannot be detected.

In many situations the blood spaces are separated by very thin septa composed of flattened endothelial cells (*Fig.* 439), but elsewhere fibrous tissue in varying amount is also present between the blood spaces; indeed, in some portions of the tumour the blood spaces are so small and the fibrous tissue so great that the structure cannot be distinguished from that of vascular fibrous tissue such as is seen in inflammatory reactions. This dense fibrous tissue might be regarded as reactive and not actually part of the growth, as corresponding to the fibrous stroma of, say, a scirrhous cancer of the breast. There is, however, another possibility, and this I believe is the more likely. In granulation tissue endothelial cells may proliferate to form either vascular spaces or fibroblastic cells which, as the reaction progresses, become transformed into white fibrous tissue. The tumour under consideration is composed of the essential cellular elements of granulation tissue, and it is conceivable that here also two modes of development may be present, one into blood spaces, and the other through fibroblasts into white fibrous tissue.

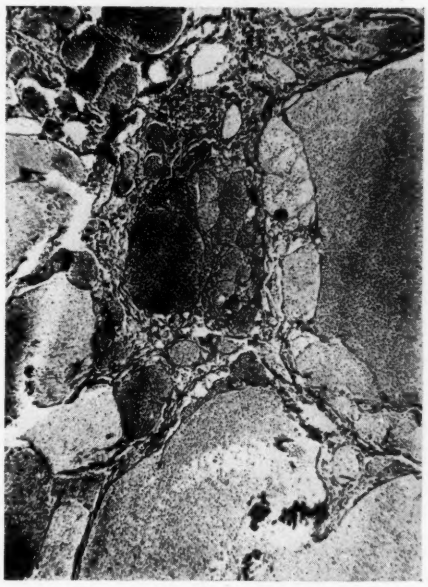

FIG. 439.—Showing the structure of the angiomatous portions of the growth. (× 60.)

Where the tumour meets the bone the changes are very interesting. I was anxious to see if, when this fibro-angiomatous growth of soft parts encroached on bone, the resulting changes would in any way simulate those seen in so-called osteitis fibrosa; but the resemblances are not as close as I expected to find them. The tumour is very fibrous near the surface of the bone, and projecting into this fibrous tissue from the bone are many spicules of various sizes. Fibroblastic and fibrous tissue can be seen filling the interstices in the thickened portions of the solid bone. In these situations the marrow within the bone is very vascular. In some of the interstices in the compact bone the connective tissue is very vascular. There is little doubt, I think, that the lesion began in the soft parts; then, encroaching on the bone, passed through it, possibly by way of natural foramina (the so-called Volkmann's canals), and extended to within the marrow cavity. The increased vascularity within the bone-marrow I regard as angiomatous and part of the lesion. Most of the spicules of bone were small (*Figs.* 440, 441); but in *Fig.* 441 the whole of the bone depicted was separated from the main shaft. It seems as if a portion of the marrow was separated with it.

In the main growth are a few plasma-cells, eosinophil leucocytes, and fairly numerous small collections of lymphocytes. All of these may be the result of superadded inflammation; but I have found scattered accumulations of lymphocytes remarkably common in angiomatous growths, and wonder if lymphoid aggregations may sometimes be an essential part of the lesion.

Calcium salts have been deposited in the tumour as indicated in the skiagram (*Fig.* 437). The deposits are small and widely scattered. Most of them are situated in thrombi within the lumina of blood spaces; they correspond to phleboliths.

A case presenting many features in common with ours was observed by Bertram M. Bernheim.[3] This was a male whose left arm first bothered him when he was 16 years old. He then noticed a little red spot on the inner side of his wrist about 1·5 cm. in diameter. It gradually increased in size until he was 47 years of age, when the limb was amputated. The left arm

FIG. 440.—Showing the fibrous character of the growth near the bone (fibula), a bone spicule projecting into the soft parts, and connective tissue filling one of the interstices in the compact bone. (× 60.)

FIG. 441.—The whole of the bone depicted in this figure was detached from the main shaft of the fibula. To the right a sharp spicule of bone can be seen projecting into the soft parts. Apparently a portion of marrow has been included in the detached portion of bone. The vascularity of the marrow is probably due to an extension of the angioma. (× 30.)

was then twice the size of the right, and in the affected limb there were no blood-vessels; instead there were huge venous and arterial blood-sinuses that twisted and turned back on themselves. The muscles resembled a huge sea sponge, and arterial blood even spurted out of the marrow cavity.

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[3] BERNHEIM, M. BERTRAM, "Congenital Arteriovenous Fistula of Left Brachial Artery and Vein, with Secondary Arterial Blood-supply to the Arm", *Ann. of Surg.*, 1925, Feb., 465.

THE SURGICAL TREATMENT OF CHRONIC BACILLARY DYSENTERY.

By PHILIP MANSON-BAHR and A. L. GREGG, London.

Chronic bacillary dysentery, a very distressing and intractable disease, too often remains unrecognized in this country, and consequently does not receive the serious attention it deserves. In India, where it was first described by Crombie, it was recognized as a separate disease—the *Morbus bengalensis*; but this is now known not to be the case. Rather it is caused by, or is a sequel to, chronic ulceration of the mucous membrane of the large intestine by the bacilli of the Flexner-Y group. More rarely, as one of us has pointed out, it may be due to Shiga's bacillus, which is usually responsible for the more virulent and acute types of bacillary dysentery.

The chronic type of the disease is comparatively common in natives of India and other tropical countries, but is rarely seen amongst Europeans. During the last five years, however, a number of cases have occurred amongst ex-soldiers and pensioners from the Great War who originally contracted the infection on the Western Front or, more usually, in some of the Eastern theatres of war.

PATHOLOGY.

The pathological appearances of the bowel naturally vary considerably in different stages of the disease. The less advanced lesions consist of shallow ulcerations which involve the mucous membrane alone (*Fig.* 442), and are found usually at the flexures of the large bowel, but may also occur in the lower ileum and extend into the rectum down to the anal margin. These ulcers are usually found on the free edges of the transverse folds of mucous membrane.

In contradistinction to the ulcerations of amœbic origin, they are serpiginous in outline, with undermined edges, and often intercommunicate with neighbouring lesions. Occasionally, at the base of the ulcers mucus-retention cysts (*Fig.* 443) form in the submucosa, in which the dysentery bacillus continues to exist in a virulent form, and it is these cases which usually become 'convalescent carriers' *and materially assist in the spread of the infection.* The isolation of the specific bacillus in these cases is usually possible only at autopsy; even then, it is by no means easy to obtain in any numbers. In order to do so successfully the bowel should be washed free from contents, and the base of the ulcer scraped and cauterized, cultures then being made from the granulation tissue by means of a platinum loop inserted under the margin of the ulcer.

In some cases this characteristic ulceration may, in time, involve the whole mucous surface, and, becoming secondarily infected by organisms from the fæces, may result in the deposition of exuberant granulation tissue. The

formation of granulation tissue is accompanied by fibrosis of the bowel wall, which, losing its elasticity, becomes thick and rigid. This process most

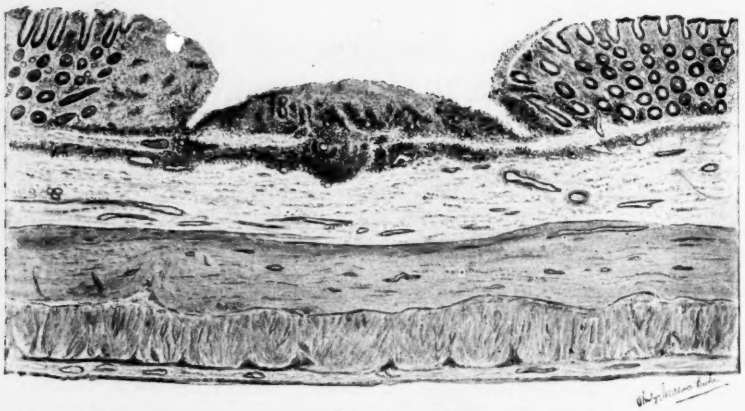


FIG. 442.—Shows the formation of a chronic bacillary ulcer affecting the mucous membrane only and not penetrating beneath the muscularis mucosæ. (Flexner-Y infection.)

usually affects the pelvic colon and sigmoid, which are the portions of the large intestine most severely involved.

The inflammation may extend to the peritoneal surface of the bowel, leading to the formation of granulations visible beneath the peritoneum.

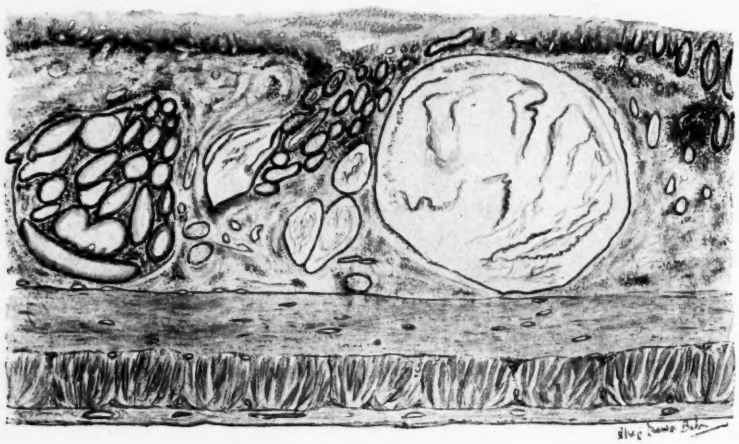


FIG. 443.—Shows the formation of submucous retention cysts, or adenomata, formed by the inclusion of portions of Lieberkühn's follicles in the scar tissue. (Shiga infection.)

Occasionally, too, large masses of granulation tissue may coalesce to form bleeding polypoid excrescences, and it is with this type of case that this paper is mostly concerned.

SYMPTOMS AND COMPLICATIONS.

Symptoms.—The chronic stage of ulceration, or granular colitis, rarely, if ever, appears to be a sequel to an acute attack of bacillary dysentery. In the patients whose histories are quoted here, the chronic stage supervened

insidiously; they have suffered once, if not oftener, from a mild or subacute dysentery from which they made a rapid and apparently permanent recovery during their war service. Relapses of diarrhœa or subacute dysentery, with mucosanguinolent stools, recurred at definite intervals, or it might not be for a year or more after demobilization. Eventually a chronic, intractable diarrhœa supervened which, though temporarily yielding to rest and diet, finally produced weakness and emaciation, often with progressive anæmia, cachexia, and cardiac disturbances. The supervention of a chronic diarrhœa may therefore be regarded as the chief objective symptom of chronic bacillary dysentery.

FIG. 444.—Sigmoidoscopic appearance of acute bacillary dysentery. Shiga's bacillus isolated. (*Philip Manson-Bahr pinx.*)

In time, and as the deposition of granulation tissue progresses, the passage of diarrhœic stools is replaced by evacuations consisting solely of blood and mucus, and this may be accompanied by acute dysenteric symptoms, such as acute abdominal pain and tenesmus. As may be gathered from the summary of our cases, eight to ten of these evacuations may be passed daily for weeks or months, till death from exhaustion takes place.

Complications.—In the latter stages of this distressing disease symptoms of general intoxication assert themselves, producing pains in the long bones and joints culminating in intra- and peri-articular effusions which may be acute and extremely painful.

Parotitis, a symptom not infrequently met with in acute bacillary dysentery, has also been noted in two cases.

Other stigmata of acute toxæmia may manifest themselves, such as bouts of pyrexia, complete anorexia, mental apathy, and stomatitis. A secondary, and maybe severe, anæmia is usually found.

DIAGNOSIS.

The diagnosis of chronic bacillary dysentery usually presents considerable difficulties. On account of the failure attending the isolation of the specific organism, which has been already referred to, one has to rely, to a great extent, on negative evidence—the history of the patient, the continued absence of pathogenic amœbæ from the fæces, and the lack of response to anti-amœbic drugs.

The microscopic examination of the fæces may in itself afford a clue, for often masses of polymorphonuclear leucocytes derived from the bowel wall may be distinguished. The presence of these cells in diarrhœic fæces is there-

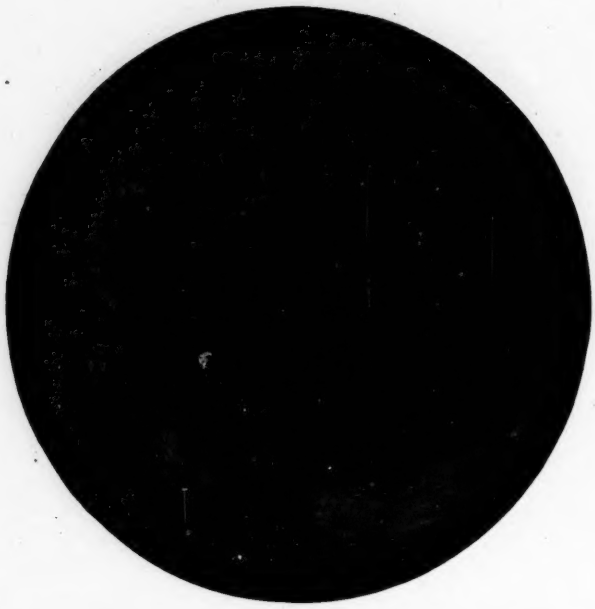


FIG. 445.—Sigmoidoscopic appearance of chronic bacillary dysentery showing glazed and granular appearance of mucous membrane due to formation of granulation tissue. (*Philip Manson-Bahr pinx.*)

fore very suggestive of chronic bacillary dysentery; in the amœbic disease these cells are usually entirely absent.

Little help can, as a rule, be derived from serological investigations. Occasionally, as in two cases in this series, the serum will be found to agglutinate Flexner's bacillus even in high dilutions, i.e., 1–100 or more, and this test may be of suggestive value. More usually, however, it affords little confirmatory evidence.

On the other hand, sigmoidoscopic examination of the bowel is most valuable and is usually diagnostic. From the fact, already stated, that the most marked lesions occur in the lower part of the large bowel, and especially in the rectum, they are usually clearly visible when the instrument has been introduced a few inches (*Figs.* 444, 445).

The distinctive features of the bowel are sufficiently apparent. The bowel itself is rigid, indurated, and inelastic, due to long-standing inflammation, a

condition which gives rise to a considerable degree of pain on the introduction of the instrument; this in itself is of considerable diagnostic value, serving to distinguish it from amœbic ulceration, which we have found to be almost invariably painless. The roughened and granular surface from which blood exudes wherever touched by the instrument is also sufficiently distinctive.

The main feature of this bowel is the granulation tissue itself; naturally the appearance varies in different cases, and in some it may be actually polypoid. Fibrosis of portions of the bowel resulting in localized strictures has also been noted. The patulous condition of the anus and the atrophic appearance of the skin surrounding the anal margin, as well as the wasting of the gluteal and perineal muscles, afford a considerable amount of additional evidence in forming a diagnosis. Redundant skin at the anal margin, and the formation of external piles, which so often accompany chronic amœbic dysentery, are seldom, if ever, seen in the chronic bacillary disease.

MEDICAL TREATMENT.

From a brief consideration of the pathological aspects of this serious condition, it is hardly a matter of surprise that drug treatment is of little, if any, avail.

Such drugs as bismuth, salol, and bolus alba merely serve to mask the symptoms temporarily, but cannot in any way mitigate the serious condition of the large bowel. The same may be said of vaccines. The specific organisms, the dysentery bacilli, play little, if any, part in the terminal stages of bacillary dysentery, so that the destruction of the mucosa and its replacement by granulation tissue have to be regarded as the aftermath of their activities. Under these circumstances we have come to regard vaccines of dysentery bacilli not only as entirely ineffective, but as actually contra-indicated. The same may be said of mixed vaccines composed of various species of the intestinal flora. The problem really becomes a mechanical one; one's efforts should therefore be directed towards diverting the fæcal stream as much as possible from the large gut, and to putting this viscus in a state of almost complete rest, so that healing may take place. Apparently regeneration of the epithelium rapidly takes place when the source of irritation is removed (*Fig.* 446).

The lines of treatment may be divided into three headings: dietetic measures, intestinal lavage, and operative interference.

Dietetic Measures.—In contradistinction to the usual practice adopted in dieting chronic amœbic cases, we are of the opinion that in the chronic bacillary disease it is necessary to supply the patient with an adequate supply of nutritious nitrogenous food. Oils and fats are particularly useful in so far as in excess they tend to lubricate the raw surface of the bowel and thus promote healing. The main aim should be to stimulate the recuperative powers of the body so as to aid the regeneration of the intestinal mucosa. This principle is also advocated by Lockhart-Mummery and others engaged in the treatment of ulcerative colitis and other conditions of the colon. If the patient has zest for food, the diet should not be restricted to milk and fluids, but he should be permitted eggs, fish, milk puddings, minced mutton,

jellies, and plenty of butter and bananas. Apparently it is not the nature of the fæcal residue which irritates the large gut, but the fact that excrementitious matter is passing through the lumen at all.

Lavage.—In the milder stages of this condition, that is, in cases characterized by diarrhœa without grave constitutional disturbance, treatment by lavage per rectum sometimes appears to be followed by good results. In many cases, however, the effect is merely temporary, and after a brief period of quiescence, the process becomes progressive once more.

Apparently the substances employed in the lavage, either as means of disinfecting the bowel surface or of stimulating the mucous membrane to repair, are not so important as the amount of fluid used to flush out the bowel. The therapeutic agents we employ at the Hospital for Tropical Diseases for this purpose are sodium bicarbonate in a 4 per cent solution, hypertonic saline, and eusol. The latter has definite antiseptic properties,

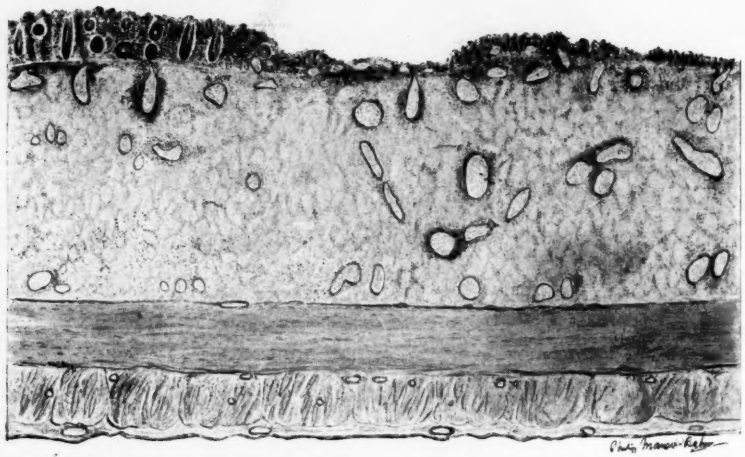


FIG. 446.—Active formation of granulation tissue on the mucous surface is taking place. The regeneration of the few remaining Lieberkühn's follicles can be seen on the left-hand side of the section, representing the process of healing.

and is therefore useful, but in addition it acts as a stimulant for the repair of the bowel. It is, however, as a general rule, most irritating, and it is necessary to dilute it very considerably in order that it may be tolerated by the patient. A 25 per cent solution of eusol is in routine use, but it may occasionally be used less highly diluted, though it produces a considerable amount of intestinal pain and, exceptionally, a toxic nephritis with hæmaturia. The other two substances tend to soothe intestinal irritation.

As regards the method of administration, the bowel should be washed free from intestinal contents by means of a tube and funnel and hot water. When the water is returned reasonably clear per anum, the solution should be run slowly into the rectum by means of a rubber tube and funnel. The tube itself should be a stout one provided with a round terminal opening, and it should not be inserted high up into the rectum, for in this situation it tends to become kinked and injure the mucosa. Not less than two pints of the solution should, if possible, be used to flush out the large gut, and the

fluid should be run in slowly, the patient in the meantime lying on his right side, and endeavouring to retain the fluid as long as possible. The time he is capable of retaining it varies considerably in individual cases from five minutes to half an hour. We are of the opinion that methods to ensure the flow of fluid through the gut, such as tipping up the end of the bed on blocks, or of inverting the patient himself, do not make any material difference.

We have recently come to regard intestinal lavage with silver salts, a method formerly in vogue, as being actually deleterious. Silver nitrate in a $\frac{1}{4}$ per cent solution is extremely irritating to the bowel in this condition, while protargol and argyrol, which are usually employed in about 4 per cent strength, are far too expensive for routine use.

On the whole the results of lavage are disappointing, though a large number of cases have been treated; in the worst, resort has eventually had to be made to operative interference. We have notes of eleven cases during the last two years treated by lavage on alternate days, in all of which sigmoidoscopic appearances showed slight formation of granulation tissue, and in which the regeneration of the mucous membrane could be observed through the sigmoidoscope to take place. The average stay in hospital was about four weeks, and each patient received about twelve treatments or more. Intestinal lavage is particularly exhausting to the patient, and no object appears to be gained by washing out the bowel more frequently than is outlined above.

One case may be quoted in support of this method :—

Case 1.—The patient contracted dysentery in France in 1917, and suffered almost continually from diarrhœa and dysenteric symptoms for six years before the treatment was applied. He had lost some three stone in body weight, and had become feeble and cachectic. Treatment by means of eusol and saline lavages was continued, with interruptions, over a period of nine months. On discharge from hospital the patient had regained his original weight and was passing two formed motions a day. Sigmoidoscopic examination showed that the bowel had regained its normal appearance, and the patient has been able to resume his occupation as a chauffeur.

SURGICAL TREATMENT.

Indications for Operation.—As a result of our experience we may state that the indications for operation should be based upon the following: signs of toxic absorption, marked intestinal hæmorrhage, sigmoidoscopic appearances indicating grave destruction of the mucosa, the formation of bleeding polypi, and the failure of properly conducted lavage. We are further of the opinion that it is not justifiable to wait till the patient is almost *in extremis* before instituting operative measures. Should the patient not respond to lavage within a reasonable time, should he continue to lose weight, the indications are that persistence in these measures will not meet with any greater degree of success, so that recourse must be had to operation. Inasmuch as dental treatment is a form of surgery, it must be accepted that no treatment of dysentery can be entirely successful if oral hygiene be neglected.

Two methods, represented by four operations, may be considered: (1) Through-and-through lavage obtained by appendicostomy or valvular

cæcostomy; (2) Fæcal drainage obtained by an open cæcostomy or ileostomy. Colostomy, apart from the rare event of stricture, has no place in the treatment of dysentery: if the disease is grave enough to warrant operation, almost the whole large gut, and certainly the cæcum, will be ulcerated; there can be no rationale for leaving a portion of diseased gut, such as the cæcum, proximal to the opening.

Appendicostomy and Valvular Cæcostomy.—These may be considered together, being identical in effect. Valvular cæcostomy is more simple to perform where a minimum of manipulation is important, but an appendicostomy removes a latent source of infection with an almost certainly diseased appendix. For this sufficient reason we prefer this method. Either operation can usually be performed under local anæsthesia; it causes little discomfort, and the wound, when permitted, will heal spontaneously. These advantages are outstanding, and the results frequently most gratifying; hence the well-deserved popularity of this method. With a small catheter in the cæcum, complete flushing of the large gut can be assured, or, by using the continuous drip, many ounces of fluid can be slowly passed into the bowel, from which it is readily absorbed by the dehydrated system. Such procedure, however, can only ensure success when adopted early. With other writers, we feel the need to emphasize this point—alas, too often overlooked.

Where the patient's recuperative powers have been undermined by long-continued toxic absorption, the success of appendicostomy will be problematical; indeed, it has been our experience that long-standing cases presenting the characteristic clinical picture of marked toxic absorption, together with the constant passage per rectum of blood, mucus, and pus, do not always obtain benefit from a small opening; complete drainage being required. The following history is illustrative:—

Case 2.—L. W., age 29, ex-soldier, contracted diarrhœa in France in 1916; intermittent relapses occurred till May, 1923, when a severe attack of hæmorrhagic diarrhœa caused his admission to the Hospital for Tropical Diseases. Dietetic and lavage treatment was instituted. Bilateral parotitis developed in June, and subsided without suppuration. By October, 1923, symptoms had improved and the patient was discharged. Re-admitted November, 1923, passing much blood, mucus, and pus per rectum.

Sigmoidoscopy revealed a congested granular and bleeding mucosa. Local 2 per cent solution of silver nitrate was applied to granulations, with no improvement. On Jan. 12, 1924, appendicostomy; still no improvement; patient now becoming emaciated and very toxic. On Feb. 13, 1924, open cæcostomy was done: it was followed at once by slow but steady improvement, patient gaining in weight and general health. At the time of writing, blood and pus are still passed per rectum, but all toxæmia has vanished. The cæcostomy has not yet been closed, but patient is able to get about, is in good health, and has increased three stone in weight.

For the purpose of through-and-through lavage we have found nothing more soothing and generally satisfactory than hypertonic saline to which occasional additions of eusol (5 oz. to the pint) are made. Lavage was usually done once daily.

Open Cæcostomy.—This also is a simple operation and can be done under local anæsthesia, but it should be noted that the gut is greatly inflamed, and usually a subacute peritonitis is present. The peritoneal nerve-endings are therefore in an irritable condition, so that even the most gentle

handling is liable to cause a dull aching pain. Two preliminary injections of morphia, $\frac{1}{6}$ gr., given ninety and thirty minutes respectively prior to the operation, are therefore very desirable. Gas-and-oxygen anæsthesia may be preferred. Our practice has been to make a muscle-splitting incision over the cæcum, draw forth the appendix and as much of the cæcum as may be judged necessary, and then shut off the peritoneal cavity by suturing the cut edges to the cæcal wall. A Paul's, or $\frac{1}{2}$-in. rubber, tube is next inserted into the cæcum through an elliptical incision which includes the base of the appendix, this organ being thereby removed. Such practice renders remote a chance infection of the peritoneum and obviates leaving a dangerous appendix. We make a point of not suturing the skin too closely around the tube; hence the wound infection which follows is mild in nature, free escape of any exudate being permitted.

One unexpected source of difficulty will surprise the surgeon unfamiliar with dysenteric ulceration. This arises from the marked degree of œdema and thickening present in the cæcal wall, which greatly hinders the introduction of the Paul's tube. An allowance of cæcum beyond the peritoneal sutures which would appear amply sufficient for the introduction of the tube may prove totally inadequate when an incision has been carried through the thickness of the gut—only an astonishingly small opening being obtained. Full provision for this must therefore be made before the original peritoneal sutures are inserted. On the other hand, all possible cæcal wall must be left in the abdomen; by so much is the eventual closure facilitated. It is because of this difficulty that a delay is not made before opening the cæcum.

Nursing difficulties commence in a week or less with the loosening of the tube, as do the patient's unpleasant experiences. The liquid and digestive fæcal material from the opening is both offensive and irritating; the former can be met by the free use of sanitas or eusol and eau de Cologne; the latter by painting the skin around the wound with ambrine at each dressing. A colostomy belt should be fitted as soon as possible.

As regards attaining the ideal of complete drainage of the fæces, it is well known that this procedure fails; peristalsis still drives a small amount of the material along the colon. To combat this tendency one of us (A. L. G.) devised the tampon-tube illustrated in *Figs.* 447, 448. It is both simple and efficacious when used as follows:—

FIG. 447.—Tampon-tube.

The tampon-tube is simply a soft rubber bulb which is fastened round an ordinary rectal tube and can be inflated at will. It is made by Messrs. Allen & Hanburys. With the bulb B (*Fig.* 448) deflated, the tube A is passed through the cæcostomy until the bulb has just passed into the ascending colon. Gentle inflation from a syringe of a known quantity of air through tube C then prevents the bulb from returning through the wound. The glass rod D is now pushed through tube A at skin level as an

anchor to prevent any advance of the bulb from peristaltic pressure. The lumen of the ascending colon is thereby blocked so that the onward passage of fæcal material becomes impossible. At the same time the central tube A permits of colonic lavage when required, reflux being prevented by a simple clip, E. By this means all the comforts of appendicostomy lavage are gained, while drainage is assured.

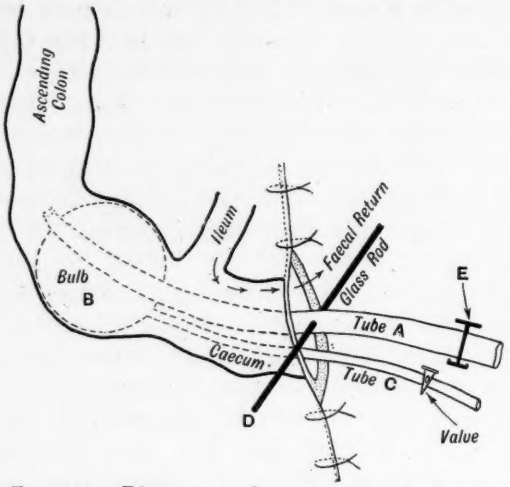


FIG. 448.—Diagram to show tampon-tube *in situ*.

Case 3.—D. C. N., ex-officer, age 43, contracted diarrhœa in France in 1916; intermittent relapses occurred until Feb. 3, 1921, when he was admitted to the Hospital for Tropical Diseases. He was debilitated, toxic, and anæmic; irregular pyrexia, 102–103°; much blood, mucus, and pus in stools, which on culture grew *B. acidi lactici*. Sigmoidoscopy showed a hæmorrhagic granular surface uniform over the bowel wall, which was thickened and showed polypoid formation. Dietetic measures and lavage failed to arrest the downward course, and the patient became exceedingly toxic. In February, 1921, cæcostomy was performed with local anæsthesia, and Paul's tube was inserted. Toxæmia forthwith decreased and the condition improved, though rectal hæmorrhage continued for some weeks. Using the tampon-tube, through-and-through lavage was continued, and gradually the patient's appetite returned, weight was gained, and the hæmorrhage ceased. A colotomy belt was then worn for some time, and by June 30 the patient was so much better that the cæcostomy was closed. Uninterrupted convalescence occurred, and he returned home at the end of July, 1921. He was last heard of in December, 1922, up to when he had maintained excellent health and had no bowel trouble other than occasional slight discomfort in the abdomen.

Once an open cæcostomy is established, the patient may be expected to improve from even the most hopeless condition. Such improvement, unfortunately, does not decrease the surgeon's anxieties, for he has yet to face the difficult problem of when to close the wound. Manifestly a permanent right-sided anus is objectionable, but prior to any operation the patient should be warned that such may be inevitable. We accept three criteria as signifying the possibility of closure:—

1. *The general clinical condition*: The patient must have gained in weight and general health, no evidence of active toxic absorption still being present.

2. *The absence of ulceration in the colon*: To determine this, *both ends of the colon are examined*; the distal end by an ordinary sigmoidoscopic examination, the proximal end by means of a cystoscope passed through the cæcostomy. If the bowel is flushed through from the anus and a clear gentle stream is kept flowing, it is surprising what an instructive view can be obtained of the whole ascending colon.

3. *Blood should have been absent from the irrigation result for some time, and no recurrence or pain should occur when the fæcal material is encouraged to pass through the colon again.* This can be done by applying a firm flat dressing

to the cæcostomy after the tampon-tube is removed, fæcal exit through the wound being thus hindered.

Not until these conditions are satisfied is it safe to close the wound, nor will the patient ever be exempt from either immediate risks or a remote relapse. For these reasons one hesitates to close the opening, and, as others have noted, such hesitation may well be justified. None the less the patient will concur that it is well worth considerable risk to be relieved of a right-sided anus, and that confidence in the patient's recovery may be justified is illustrated by the following history :—

Case 4.—A. V. C., age 27, ex-soldier, contracted diarrhœa in France in 1917, with passage of blood and mucus. There were occasional recurrences up to June, 1920, when he was admitted to the Hospital for Tropical Diseases. He was then very anæmic and passing much blood and mucus. Tachycardia, abdominal pain, and irregular pyrexia were marked ; the condition was very suggestive of tuberculosis, and became critical. Treated by diet, salines, lavage—all useless. On July 17 one of us (A. L. G.) was asked to perform open cæcostomy. Following this, through-and-through lavage kept the colon clear. The patient's general condition and local symptoms slowly improved, so that on Oct. 6 the cæcostomy opening was closed. Both operations were done under general anæsthesia. Uninterrupted convalescence followed and patient was discharged on Nov. 1, 1920. He resumed his trade as blacksmith some weeks later, and still follows it without any disability or recurrence of dysentery. In October, 1925, he reported that he was perfectly fit and well and enjoying life.

Ileostomy.—This has been advocated to meet the drawback of cæcostomy already mentioned, viz., the passage of some fæcal material through the colon.

We have carried out this method : it must of necessity relieve the large bowel completely ; it is simple to perform, and no more dangerous to close than a cæcostomy. Against ileostomy, however, we urge the loss of an important sphincter and portion of the digestive tract. The use of the tampon-tube permits the advantages, hitherto obtained only by an ileostomy, of complete fæcal drainage. Further, the possibility of being able at will to direct the fæces through the colon when estimating the time for closure is an immense advantage which is ruthlessly sacrificed by ileostomy.

There remains, then, but one definite indication for ileostomy, namely, an extension of the inflammatory process into the lower portion of the ileum. Should such grave instances arise—a rare occurrence in chronic cases—we prefer to make the bowel opening a short distance proximal to the ileocæcal sphincter and to the inflamed gut. The following patient illustrates such a condition :—

Case 5.—W. S., age 45, ex-soldier. Served in France 1916–19. Diarrhœa with blood began in 1920 and lasted three months. It recurred in September, 1923, and continued up to Feb. 18, 1924, when he was admitted to the Hospital for Tropical Diseases. Average of six stools daily, with much blood, mucus, and pus.

Sigmoidoscopy : examination painful ; granular bleeding bowel, which was narrowed and fibrotic, elasticity being lost. Lavage treatment failing, on March 7, 1924, a loop of the ileum was brought out of the abdomen, as the inflammatory condition of the bowel was seen to extend about 8 in. into the ileum. Three days later the bowel was divided and a catheter introduced into the distal end. Through-and-through lavage was maintained. Stronger solutions of eusol were tried, but an

acute nephritis followed, fortunately only transitory. Apart from this, steady gain in health ensued, although the passage of blood and pus per rectum continued.

The patient was discharged on June 14, 1924, and reports from time to time. His general health and condition are now good, but the passage of blood and pus persists and contra-indicates restoration of the alimentary tract.

It has been pointed out that, after some months' disuse, a bowel badly ulcerated originally, may become so stenosed that any attempt to close the artificial anus is doomed to failure from partial obstruction. That such a condition may occur was demonstrated at the autopsy on one patient whose death was in the nature of a calamity. Possibly this patient had had both amœbic and bacillary dysentery, but we are sceptical as to the finding of the dysentery amœba as reported.

Case 6.—H. H., age 25, ex-soldier, served in Salonika, where in 1917 he contracted dysentery, and *Entamœba histolytica* was reported to have been found. He

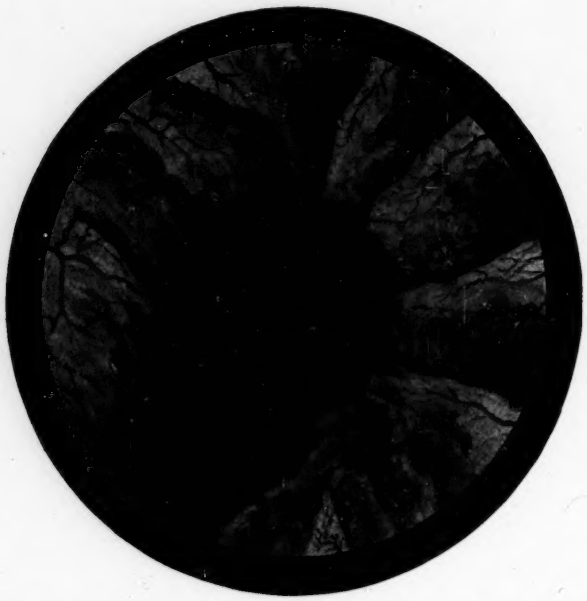


FIG. 449.—*Case* 6. Sigmoidoscopic appearance of chronic bacillary dysentery showing partial fibrosis of the bowel wall and formation of ridges of granulation tissue. (*Philip Manson-Bahr pinx.*)

was treated with emetine, but in spite of this had continual relapses for six months. These gradually cleared up with bowel lavage, but in 1918 and again in 1919 he had severe relapses. On Nov. 8, 1921, he was admitted to the Hospital for Tropical Diseases, very ill with severe dysentery symptoms. Patient was very toxic and very weak from loss of blood, his condition being critical, so that on Nov. 10, one of us (A. L. G.) was asked to do cæcostomy. A portion of the cæcum was sectioned, and showed well the œdematous musculature, small-celled infiltration, and hæmorrhage at the base of the necrosed mucosa. The tampon-tube was used, and the patient slowly but steadily improved. Sigmoidoscopy in January, 1922, showed the bowel to be very granular and fibrotic (*Fig.* 449), and sphincteric control was absent. From being in a state of extreme emaciation and anæmia, patient became well covered and reasonably robust. Progress was interrupted by a thrombosis of the left femoral

vein, but this subsided without ill effects. Throughout, the patient complained of tenderness over the sigmoid colon.

On May 23, 1923, the case-sheet records: "Motions formed; general condition greatly improved; wound getting smaller." The cæcostomy opening became so stenosed that it ceased to function properly, and pain recurred in the abdomen. On July 7 a finger was introduced into the cæcum to dilate the opening slightly. Next day the patient was much more comfortable, but on July 9 all the signs of acute septicæmia suddenly developed, and death occurred on July 11.

Autopsy findings were those of acute septicæmia, and only *B. proteus* was isolated. In contrast to the previous emaciation the body was excellently nourished, and the colon was almost completely healed. There was in the sigmoid a markedly stenosed portion about 1½ in. wide—evidently the site of a severely ulcerated area and of the patient's tender spot.

It will be seen from the above that only a small portion of the bowel was stenosed; we believe that this is what may usually be expected in cases

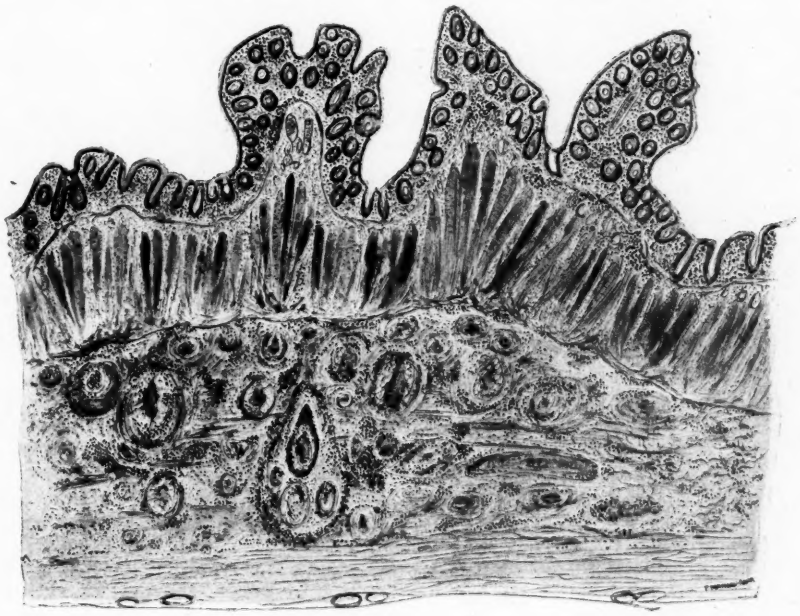


FIG. 450.—Tuberculosis of longitudinal muscular coat of the large intestine secondary to bacillary dysentery.

where stenosis occurs. We therefore prefer to close a cæcostomy working first from within the abdomen through a paramedian or mid-line incision, which permits of a careful preliminary inspection of the whole large bowel. Any unduly constricted portion can then be detected, safely removed, and an anastomosis carried out, closure of the cæcostomy being, of course, postponed.

There is one danger of which we were previously unaware. We have come to regard the coexistence of tuberculous infection of the large bowel engrafted on to chronic bacillary dysentery as a serious danger. It is possible that the tubercle bacillus finds a congenial nidus in the previously existing granulation tissue, or becomes spurred into activity by the general devitalization of the mucous surface, and in some cases this has clearly happened, the

tuberculous process appearing to extend chiefly in the circular muscular coat of the colon (*Fig.* 450). In three cases in the period covered by this work, we have been able to demonstrate tubercle bacilli in scrapings made from the bowel wall through the sigmoidoscope.

We are of the opinion that the results obtained in this limited number of cases are striking, and justify the view that operative measures are strongly indicated as being the only rational method in this singularly chronic and intractable disease.

SUMMARY.

1. Bacillary dysentery of a mild type may result in a progressive and chronic ulceration of the large bowel in which the specific dysentery bacillus plays but the initial rôle.

2. The resulting condition is usually not amenable to medical treatment, and life may be preserved only by surgical intervention.

3. Indications for operation lie in the persistence of toxæmia and loss of weight in spite of colonic lavage.

4. Appendicostomy may be performed as a measure of relief, but cæcostomy may be required.

5. Cæcostomy with the use of the tampon-tube supplants ileostomy except in cases in which the small bowel is involved.

6. The question of closure is a matter for careful consideration in each case; temporary closure with dressings assists the operator in making his decision.

7. Stenosis of the bowel to any serious extent is rare, and when it does occur is likely to be localized, so that excision may be practicable.

8. Tuberculous infection may be superimposed upon a chronic ulcerated dysenteric bowel.

Our best thanks are due to Dr. W. F. Whaley, lately House Physician to the Hospital for Tropical Diseases, for his help in collecting the information contained in this paper; and to Dr. G. C. Low for his kind permission to make reference to cases under his care.

THE CLOSURE OF CONGENITAL CLEFTS OF THE HARD PALATE.

By ANDREW CAMPBELL, Johannesburg.

On considering the various operative measures in use at the present day for the closure of congenital clefts of the hard palate, there are a few points in the technique which strike the operator as being somewhat unsound and capable of improvement. Each cleft-palate defect is a problem presenting difficulties which have to be overcome by the most suitable methods.

When a unilateral cleft of the hard palate associated with a high palatal arch is seen, the surgeon does not experience much difficulty in making up his mind, because ample flaps are available and also a choice of operations. On the other hand, if there are bilateral clefts with scanty tissue available for flaps, then he is not in such a happy position. If the flaps have to be cut large, there is left a correspondingly large raw surface which cannot be avoided. This raw surface left in the mouth after operation is a source of anxiety to the surgeon, and is probably the most frequent cause of operative failure. The introduction of stitches is a tedious part of the procedure, and it requires considerable patience and skill before the suture line is considered to be satisfactory. Often a few of the individual stitches tear out after completion of the operation, and no matter what care is taken, there is bruising and tearing of the tissues in the most vital part—the suture line. The larger the number of stitches introduced, the greater is the traumatism. A certain number of surgeons must have concluded that the methods now in use are not satisfactory, otherwise they would not recommend the wearing of an obturator after the closure of the cleft in the soft palate. An obturator must be a nuisance to everybody concerned; it is quite impracticable in growing children owing to the necessity of changing it frequently; there is difficulty in fitting; it is frequently not worn; and it harbours débris, etc., rendering the nasal passages more prone to infection. It may be dislodged and become impacted in the pharynx or elsewhere.

It is not the intention of the writer to belittle the classical operations which have been so successfully performed, but he wishes to point out certain disadvantages, which may be summarized as follows: (1) A low palatal arch and a wide cleft are difficult to deal with by any operation; (2) Bilateral clefts require large flaps, and these leave large raw surfaces in the mouth; (3) The large number of stitches introduced in most operations and the consequent injury to tissues devitalize the line of union; (4) The time occupied in operating in all but simple cases is unduly long; there is considerable hæmorrhage and shock, while death follows in some cases.

The following description refers to an operation which is practised by the writer and overcomes those disadvantages which have been detailed.

The operation evolved itself in the case of an adult female with a complete unilateral hare-lip and cleft palate. No one had made an attempt to operate on this patient, and she presented herself at the out-patient department for relief of a deformity which must have been a source of embarrassment to herself and to others. The gap was wide and the septum was deflected, as is usual, to the same side as the gap. It seemed obvious to a nasal surgeon that it would be easy to employ the septal tissue in the closure of the gap. This was accordingly done with success.

The original intention was to turn over the lower part of the septum complete with cartilage and attach it to the lateral margin of the gap, but the cartilage became detached and consequently only the two opposed muco-perichondrial flaps were utilized in the closure. It formed a serviceable palate, and after the hare-lip operation the patient left the hospital satisfied with the result. She visited us recently after a lapse of nine months, and the condition of the hard palate is still satisfactory.

It is to be noted that no raw surface except the line of suture was exposed in the mouth, and the loss of the septum was of little consequence to the patient. There are many individuals who have lost a large part of their nasal septa through no fault of their own and are none the worse for it. This particular patient is quite comfortable, with a serviceable hard palate, in spite of the absence of perhaps a quarter of her nasal septum.

This case led the writer to think more of the nasal septum as a tissue eminently suitable for the purpose of filling defects of the hard palate. It is within easy reach, there is enough septal tissue to fill the largest imaginable gap, it is highly vascular, and it heals well under very adverse conditions; while a loss of part of it is not detrimental to the patient.

TECHNIQUE OF OPERATION.

The technique of the operation as performed at present is as follows, and the description is applicable alike for a unilateral complete or incomplete cleft of the hard palate. A bilateral cleft may, for purposes of this operation, be looked upon as a unilateral cleft on both sides, with the septum conveniently free in the middle line for the removal of adequate flaps.

The first step consists in the formation of the *palatal flap*, and involves the reflection of a flap from the buccal surface of the palate on the same side as the cleft, with its base on the lateral margin of the cleft. The width of this flap is approximately a little larger than the width of the cleft—that is to say, if the cleft were uniformly 1 cm. wide, the flap would be 1·2 cm. wide. The incision is made parallel to the cleft margin and goes down to bone. It extends as far as the posterior border of the hard palate, and the ends of the incision are then joined to the margin of the cleft. The mucoperiosteum is reflected medially as far as the margin of the gap in the bone, and the hinged flap thus formed is turned upwards so that it comes to lie with its medial edge in apposition to the lower edge of the septum and with its raw surface looking downwards into the mouth (*Figs.* 451, 452).

The second step consists in the formation of the *nasal flap*, and this is carried out by measuring the distance between the lower border of the septum

and the unreflected or lateral edge of the palatal incision. If we suppose this to be 1·2 cm. posteriorly at the junction of the soft and hard palates, then we place a mark on the nasal septum about 2·5 cm. vertically above its lower border. If the gap narrows anteriorly to 0·5 cm., then again we mark a point above on the septum 1·2 cm. from the lower border. A line of incision is thus outlined on the mucous membrane of the nasal septum. With a rectangular knife a horizontal incision is made from behind forwards along this line, cutting through the mucoperichondrium as far as, but not into, the cartilage of the septum. The anterior and posterior ends of this incision are now joined to the lower border of the septum. With an elevator the mucoperichondrium is turned down so that it hangs as a curtain in the mouth. This nasal flap has its base at the medial margin of the cleft, its raw surface looking into the nose and its lateral edge in approximation with the lateral edge of the palatal incision (*Figs.* 451, 452).

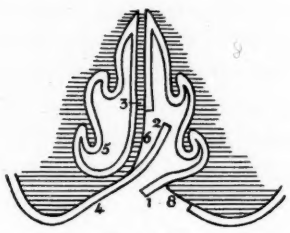


FIG 451.

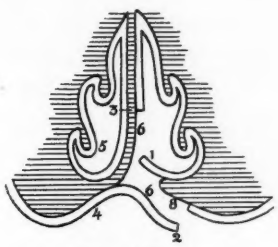


FIG. 452.

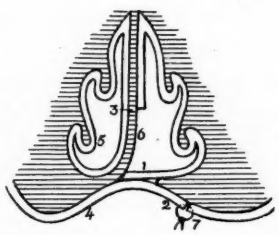


FIG. 453.

FIGS. 451, 452, 453.—Operation for cleft palate. 1, Palatal flap; 2, Septal flap; 3, Nasal septum; 4, Palate; 5, Inferior turbinal; 6, Septal raw surface: 7, Suture line; 8, Palatal raw surface.

The third step consists of the introduction of one or two sutures uniting the upper and lower flaps at the base of the septal flap. This, however, is not always necessary; but the lateral edge of the nasal flap is sutured to the line of the palatal incision with three or four stitches. This completes the operation, and after a little practice it does not take more than twenty minutes to perform it as described.

On reconsidering the procedure, we find that nasal raw surface has been applied to palatal raw surface and the line of union is no longer a line but a broad plane of union (*Fig.* 453). There is no raw surface in the mouth or in the floor of the nose. The cleft is covered by two flaps, one above the other, both of which contain periosteum. A small perforation made during the elevation of the flaps is therefore not a very serious accident. A palate composed of two flaps and with an absence of raw surfaces above and below is

obviously in a healthier condition than one where two palatal flaps have been united end to end, or where there is only one flap with its raw surface looking towards the mouth. Stitching has been reduced to a minimum, and it does not matter whether the cleft is wide or narrow, whether the palate is high or low. The only raw surface remains on the side of the nasal septum from which the septal flap has been cut. We have thought of grafting this surface with epithelium, but so far have not attempted it. It should be easy to retain such a graft with a little gauze packing, provided the graft was applied prior to the suturing of the flaps. If grafting is considered necessary, the method used for grafting the cavity after the radical mastoid operation is recommended.[1] However, so far we have found that the raw surface on the septum is of little consequence. There is oozing for a few hours and a little serous discharge for a few days longer. There is no tendency to sloughing of the septal cartilage, and this is not surprising because of the excellent blood-supply from the opposite side; also the nose is more or less sterile, as nothing but fresh air passes over the raw surface. If one deals with a bilateral cleft, the same operation is done on the other side, but it is wise to wait until the raw surface on the septum is entirely healed—a period of from four to six weeks (*Fig.* 454).

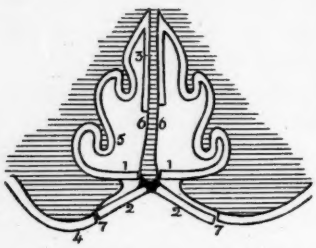


FIG. 454.—Operation for double cleft. 1, Palatal flap; 2, Septal flap; 3, Nasal septum; 4, Palate; 5, Inferior turbinal; 6, Septal raw surface; 7, Suture line.

Only a few minor points remain to be commented upon. In children the amount of septal tissue available is always plentiful and well nourished if the patient is in a suitable condition for operation. In adults we have not as yet had enough experience to make any definite statement; sufficient tissue must be available, but it may be very thin. The presence of septal tissue in the mouth gave us some uneasiness to begin with, but all the sensory branches of the fifth nerve and branches of the olfactory nerve supplying the nasal flap must have been severed by the incision. Therefore there is no tendency to sneezing or other unpleasant sensations on contact of food with the new hard palate. It is more convenient to close the cleft in the soft palate first by the usual methods before attempting the closure of the hard palate and alveolus. It is preferable to leave the hare-lip, if any, to the last, as it provides more room for working comfortably in the nose. Cases are met with where the hare-lip has been closed by others, and in one recent case with which we dealt the cleft had been complete originally, but the alveolar part had been united by operation or had obliterated itself after the hare-lip operation. This closure of the hare-lip did not present any difficulty in forming the septal flap.

A word of warning is necessary in relation to the separation of the nasal flap. The mucoperichondrium of the nose separates easily, but it is also apt to be easily perforated, and when this occurs a small perforation is liable to gape widely. The palatal flap, however, will fit over the perforation. A knowledge of the anatomical relations of the septal cartilage and perichondrium, with the vomer and its periosteum, will reduce the possibility of perforation to a minimum.

The operation is by no means one restricted to the nasal surgeon. The bleeding is at no time troublesome, especially if a little weak cocaine is packed against the septum for a few minutes after the patient is under the anæsthetic. The use of a suction apparatus to free the pharynx of any blood and secretion which may collect is strongly recommended. Only one assistant is necessary, who has little to do except prepare the stitches and have the swabs ready. The instruments required are very few: a suitable rectangular knife for the septal flap, a scalpel for the palate. one small elevator, one pair of toothed forceps, and a few small half- and fully-curved needles and needle holder (Lane), with fishing gut or even catgut.

The after-treatment is almost negligible, except that the operator's attention is focused on keeping the nose clean by means of a mild oily antiseptic spray. The stitches may be removed in from four to ten days. Hæmorrhage is more to be feared from the nose than from the palate, but so far it has not been found necessary even to pack the nose.

The method has been sufficiently successful in our hands to recommend its trial by other surgeons, and it is hoped that they may record their results of a departure from the classical operations at present in general use.

REFERENCE.

[1] *Jour. Laryngol. and Otol.*, 1923, Sept., 471.

SIMPLE TUMOURS OF THE LARGE INTESTINE AND THEIR RELATION TO CANCER.

By CUTHBERT DUKES, London.

That simple tumours of the mucous membrane of the large intestine are often followed by a cancer of the bowel wall is well known to pathologists and surgeons. Thus, in the disease multiple adenomata of the intestine—a lesion which appears persistently in certain families—statistical evidence has shown that cancer supervenes with remarkable regularity, arising, it is believed, in one or more of the multitude of papillomata which stud the mucous membrane. Again, the shaggy villous type of papilloma, though innocent at

Fig. 455.—Portion of colon removed by operation from a case of multiple adenomata. Note the little round tumours scattered over the mucous membrane. (*M.A.* 5.) (× ¾.)

first, is notoriously prone to assume a malignant character. The pedunculated polyp need not be regarded with the same anxiety, but even with this attention has often been called to the fact that a cap of malignant cells may later cover these projecting growths. The relationship which exists between simple and malignant tumours of the large intestine is the main theme of this article, which reports investigations undertaken to define this relationship more exactly. The subject may be presented most conveniently by considering the problem from the following points of view: (1) *The development and structure of the simple adenoma*; (2) *The association of simple with malignant tumours*; (3) *The intimate structure of early adenocarcinomata of the rectum and colon.*

1. THE DEVELOPMENT AND STRUCTURE OF SIMPLE ADENOMATA.

Fig. 455 shows a portion of the colon in a case of multiple adenomata. The whole large intestine from cæcum to sigmoid was studded with innumerable smooth rounded tumours, most of them about 1 mm. in diameter, a few pedunculated but the majority sessile. No cancer was present. The patient,

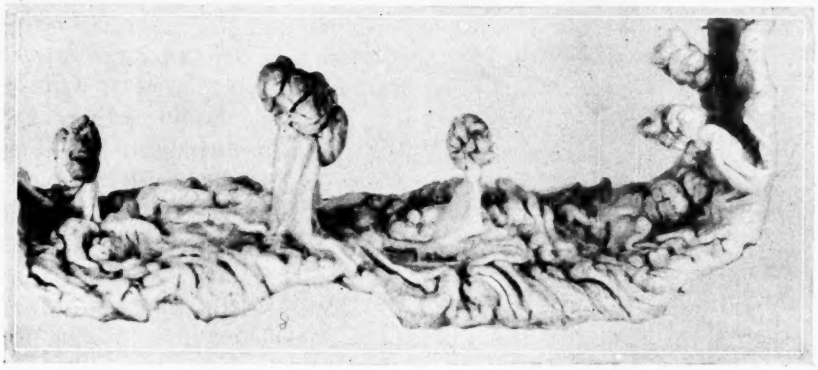


FIG. 456.—Portion of colon removed by operation from a case of multiple polypi. (× ¾.)

a young woman of 31, belonged to a family in which multiple adenomatosis and cancer of the bowel were exceptionally common.* *Fig.* 456 is from a case of multiple polypi of the colon. These two pictures serve to show the naked-eye character of the material whose intimate structure has been studied in serial sections cut through the tumours and surrounding intestine. My views are based on an examination of several portions of the intestine of three cases of multiple adenomata and an examination of more than sixty specimens of adenomata, polypi, and villous tumours sent for laboratory examination at St. Mark's Hospital during the last four years.

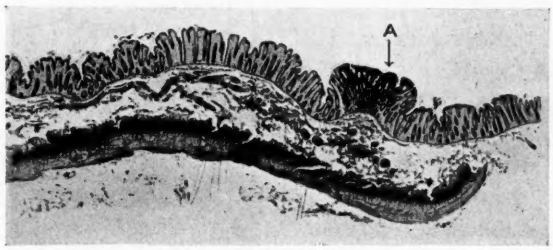


FIG. 457.—Section through a very early tumour from a case of multiple adenomata. Note small area of epithelial hyperplasia A) distinguished by cells with deeply-staining nuclei; also forward bending of muscularis mucosæ. (*M.A.* 5.) (× 8.)

Adenomata arise from small areas of increased epithelial growth which can be distinguished under the microscope by the fact that the cells secrete

* Mr. Lockhart-Mummery, who operated on this patient, has recently published her family history in a paper entitled "Cancer and Heredity", *Lancet*, 1925, i, 427.

less mucus than their neighbours and their nuclei stain more deeply with hæmatoxylin. This condition is well shown in *Fig.* 457. The more active growth of the epithelial coat results in a projection into the lumen of the bowel, accompanied by a bowing of the attached coat of muscularis mucosæ. *Fig.* 458 shows two such early tumours.

The various stages in the growth of adenomata, whose mature form will be illustrated in subsequent photographs, is represented in *Figs.* 459–463. Here the secreting cells of the large intestine are depicted as a folded coat closely adherent to the muscularis mucosæ and the scaffolding of reticular tissue, muscle, and vessels which the muscularis mucosæ supplies to the spaces between the crypts. If the epithelial layer between the points marked 1 and 7 in *Fig.* 459 grows more rapidly than neighbouring districts, the first result must be an increase in depth of the crypts, accompanied by an elongation of the scaffolding which rises at right angles to the muscularis foundation, a state of affairs indicated in *Fig.* 460. This achieves a slight increase in secreting area. Should the impulse to more active growth or function continue to act in the same region, then the first stage of tumour formation proper must occur, the essential features of which are, as is shown in *Fig.* 461, a forward bending of the muscularis mucosæ in order to provide a more extensive base to support the growth, and a further lengthening and branching of the scaffolding structure. The assumption of this form enables the same foundation of bowel wall to accommodate a greatly increased surface of secreting cells, but this advantage is purchased at the cost of serious injury to the hitherto unaffected cells situated at the boundary of the young tumour. *Fig.* 462 shows that because of the compression to which these marginal cells are exposed the crypts become stunted, and the constant friction leads to 'collar catarrh': of this important consequence of tumour growth more will be said later. *Fig.* 463 depicts the further growth of an adenoma whereby it becomes pedunculated. These diagrams speak for themselves, and I need do no more than call attention to the stunted growth at the collar of the tumour, to the continued branching of old and appearance of new scaffolding, to the almost inevitable formation of cystic spaces,

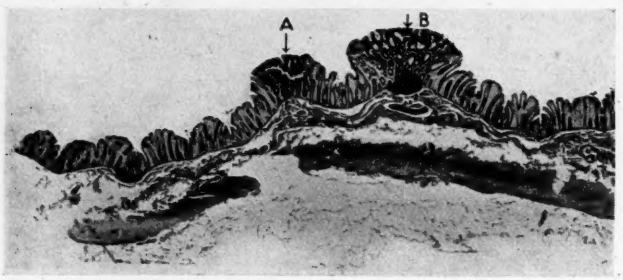


FIG. 458.—Another section through two early tumours from same case as *Fig.* 457. A collection of lymphoid cells obscures the bending of the muscularis mucosæ below the larger tumour. A, B, Early adenomata. (× 8.)

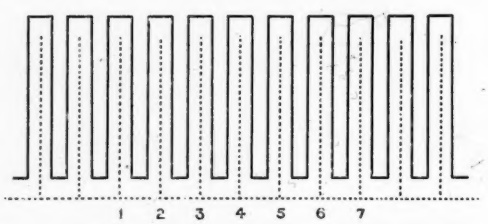


FIG. 459.—Diagrammatic representation of normal mucous membrane, the secreting cells figured by the continuous lines and the muscularis mucosæ and reticular tissue by the dotted lines.

and finally to the fact that secondary changes may begin to appear in the mucous membrane adjoining the primary tumour.

This description of the mechanics of tumour formation is built upon the supposition that the only operative factor is a more lively multiplication of epithelial cells within a defined area. It is opposed to the view that adenomata owe their origin to some submucous structure such as a lymphoid follicle bulging the secreting cells into the lumen of the gut, of which I found no evidence. Chronic inflammation is, of course, a frequent precursor of tumour growth, but if any such antecedent influence had acted in the tumours I have studied, it left no permanent imprint on the tissues.

In view of what will be said in the succeeding section on the association of simple with malignant tumours, it will prepare the ground to record the frequency of adenomata in the intestines of patients dying from diseases other than cancer of the large bowel. Thanks to facilities granted by University College Hospital, the Middlesex Hospital, and the Cancer Hospital, I have been able to examine 127 intestines which I have searched for simple tumours from cæcum to sigmoid. One or more tumours were found at some point in the bowel in 12 of these, which indicates a distribution of 9·4 per cent. In one patient 6 tumours were present, in one 4, in one 2, and the other nine contained only an isolated polyp. Of the 12 patients, 4 were women and 8 men. The average age of death amongst the patients with tumours was 46 years, and amongst the patients free from tumours 38 years, which gives support to the view that intestinal tumours are more frequent in later years.

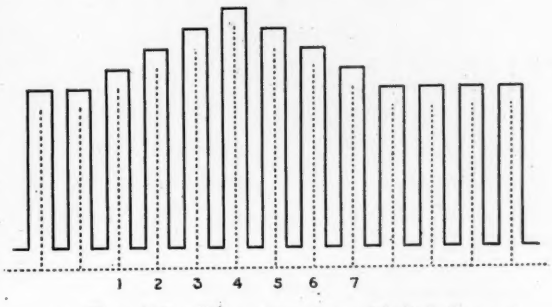


FIG. 460.—First stage in epithelial hyperplasia. Deepening of crypts and lengthening of villi.

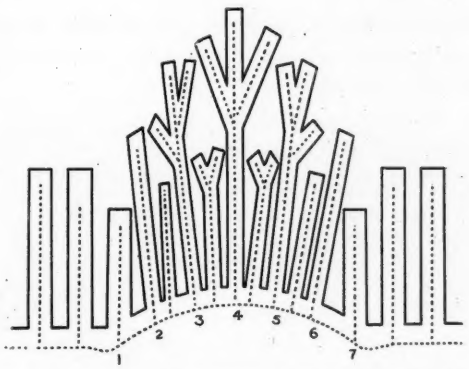


FIG. 461.—First stage in tumour formation. Bending of muscularis mucosæ, branching of original villi, and birth of new villi; stunted growth at margin.

2. ADENOMATA ASSOCIATED WITH CANCER.

In the last 33 consecutive cases of cancer of the rectum and sigmoid at St. Mark's Hospital I have made a special search for adenomata in the portion of the bowel removed at operation, and found these tumours in 25 cases. These little tumours are easily seen before the piece of bowel is hardened in fixative solution, but the shrinkage and distortion caused by formalin make them much less easy to find. They are demonstrated most clearly if in the

fresh specimen the mucous membrane and submucosa are dissected off the muscle wall immediately; then they stand out prominently as little hillocks on the plane surface surrounding the cancer. Some are similar to the little tumours, about one millimetre in diameter, familiar in multiple adenomata; others grow to large pedunculated polypi. Within a radius of three inches from the margin of the cancer a few of these tumours can nearly always be found if the specimen is examined in the way described. The before-mentioned frequency of 75 per cent (25 cases out of 33) is probably too low an estimate, because, by the surgical operation—whether perineal excision or even abdominoperineal—only a few inches of intestine are removed above and below the growth, and I have not had an opportunity of examining the rest of the bowel in these cases.

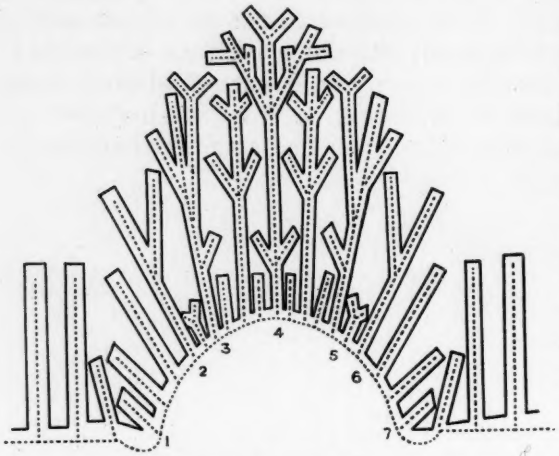


FIG. 462.—Stage intermediate between non-pedunculated and pedunculated tumour. Note increased bending of muscularis mucosæ and further branching of villi, leading to a great increase in secreting area. 'Collar catarrh' would be established at this stage.

This series of cases is not strictly speaking comparable with the investigation reported above, whereby tumours were found in 9·4 per cent of patients dying from disease other than cancer of the bowel, because in studying the normal distribution of adenomata the whole intestine from cæcum to sigmoid was examined after the tissues had been hardened in fixative, whereas in the cancer series only a few inches of bowel around the cancer were examined in the fresh condition. Accepting these reservations, both sets of figures are of considerable interest and lead to the conclusion that well-developed adenomata

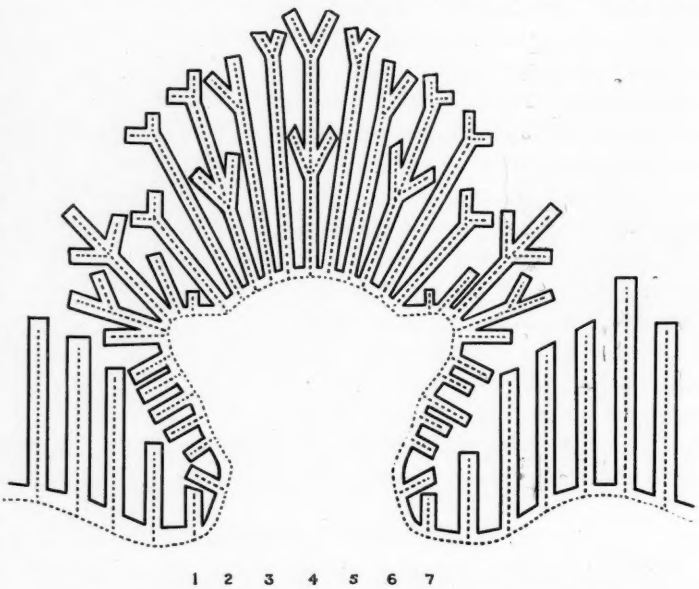


FIG. 463.—Second stage in tumour formation, showing development of stalk. Note stunted growth at margin, leading to 'collar catarrh'. The bending of the muscularis mucosæ on either side points to the development of secondary tumours which will surround the primary.

are found in the portion of bowel between cæcum and sigmoid in only about

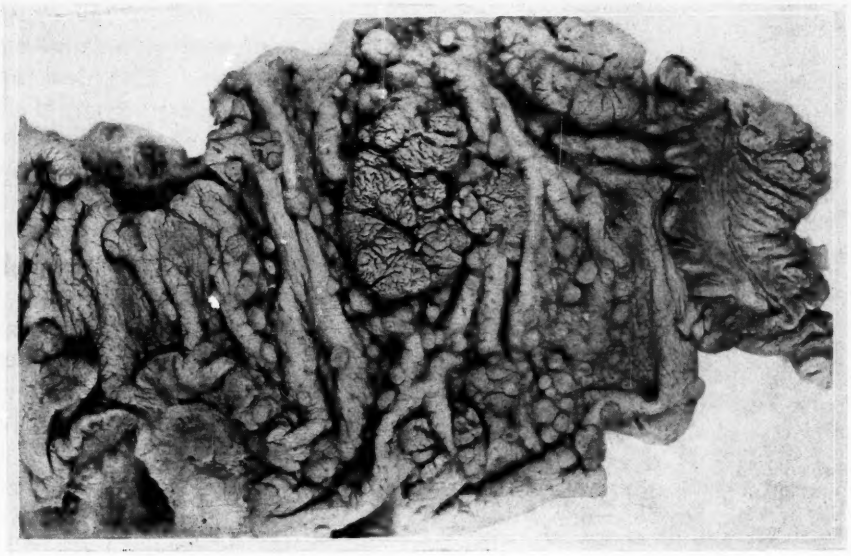


FIG. 464.—To show the naked-eye appearance of the simple tumours associated with a cancer of the rectum.

10 per cent of the population, whereas little tumours are almost invariably present in the mucous membrane surrounding a cancer of the rectum or sigmoid.

In order to gain further light on the relationship which exists between simple and malignant tumours, serial sections were cut through the cancers, through the neighbouring mucous membrane, and through the associated adenomata. The conclusions reached from a study of sections through the cancer may be left to the third part of this paper, which treats of the adenomatous structure of cancer: here only the surrounding mucous membrane and associated adenomata will be described.

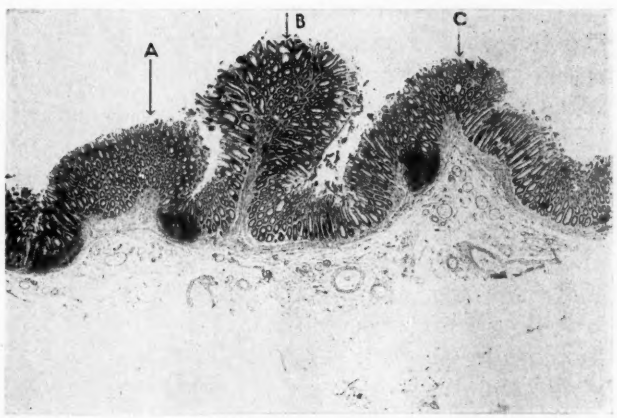


FIG. 465.—Section through a small pedunculated adenoma, one of twelve tumours arising from the mucous membrane in the neighbourhood of a cancer of the rectum. Secondary tumours (A, C) are developing on either side of the primary pedunculated tumour (B). Note 'collar catarrh' in groove between primary and secondary adenomata. Same case as *Figs.* 466–470. (*M.A.* 3.) (× 8.)

Fig. 464 is reproduced to show the naked-eye characters of the adenomata or papillomata surrounding a cancer of the rectum. In a case similar to

this twelve tumours varying from 1 to 3 mm. in diameter were found in the three inches of mucous membrane surrounding the cancer, and these were all removed for examination together with several pieces of mucous membrane of natural appearance. The low-magnification photographs (*Figs.* 465–471) illustrate the following features to which I wish to draw attention:—

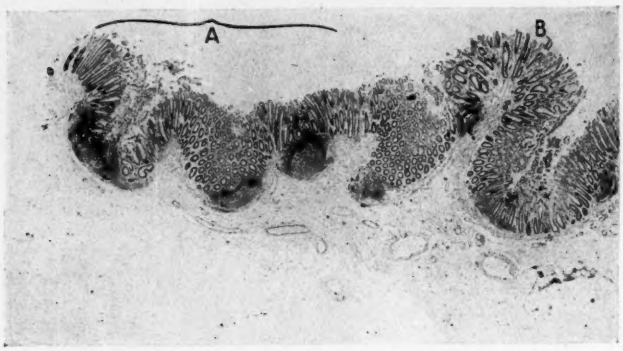


FIG. 466.—Section from another pedunculated adenoma from same case as *Fig.* 465. Note: A, Great irregularity of neighbouring mucous membrane giving birth to secondary tumours; and B, Primary adenoma with 'collar catarrh'. (*M.A.* 3.) (× 8.)

1. These tumours are essentially similar in structure to those described in the previous section: they consist of a central stroma of connective tissue with dilated blood-vessels and are covered by a thick layer of columnar epithelial cells.

2. Round the neck of the tumour the epithelial proliferation is hampered, and in the sulcus which separates the tumour from the surrounding mucous membrane a chronic catarrh exists, a condition which I have described as 'collar catarrh' (*Figs.* 465–468, and 470).

3. Owing probably to this irritation other tumours arise on either side, so that a circle of secondary tumours comes to surround the primary (*Figs.* 465–467, and 470).

4. When the increased epithelial growth affects an area greater than can be compensated for by a projecting growth, a folding of the mucous membrane follows, and some secreting cells are pushed into the region of the submucosa (*Figs.* 467–470).

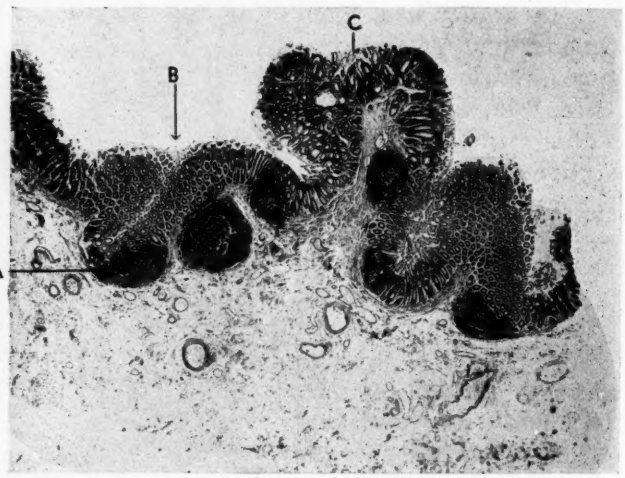


FIG. 467.—Section through another pedunculated adenoma from same case as *Fig.* 466. Note increase of lymphoid tissue at points where mucous membrane is folded inwards. A, Lymphoid follicle; B, Infolding of mucous membrane; C, Primary adenoma. (*M.A.* 3.) (× 8.)

5. Round such an infolded column of cells the normal lymphoid tissue is greatly increased and collected in conspicuous follicles, often forming a cap round the displaced secreting cells (*Figs.* 467–470).

6. Those parts of the mucous membrane in the neighbourhood of a

cancer of the rectum which bear no tumours visible to the naked eye show under the microscope a curious 'switchback' appearance, as though the epithelial growth were alternately increased and diminished (*Fig.* 471). This 'switchback' appearance is very common in the mucous membrane surrounding a cancer.

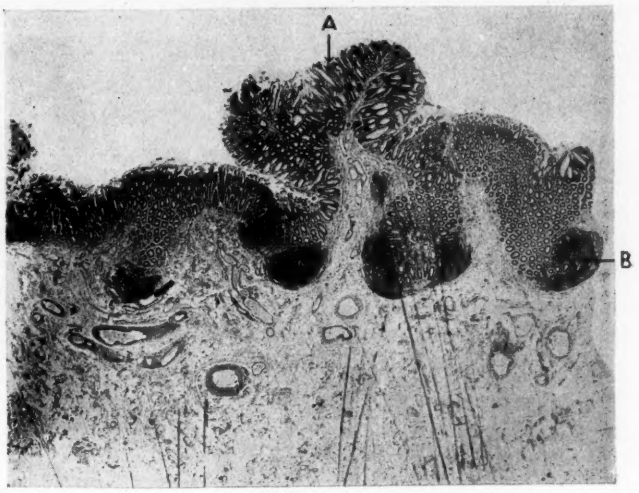


FIG. 468.—Another section through the same tumour as *Fig.* 467. A, Primary adenoma; B, Cap of lymphoid tissue covering inward folds of mucous membrane. (× 8.)

Two further characteristics of these simple tumours which bear upon our problem are revealed by higher magnifications. *Fig.* 472 illustrates the fact that some of the cells of an adenoma secrete mucus and others do not. *Fig.* 473, which was taken from an actively growing adenoma in which many mitotic figures were found within the epithelial cells, illustrates the fact that, when branching of the stroma cannot keep pace with the continued epithelial hyperplasia, then the columnar cells become stratified several layers deep or may even sprout out into the lumen, forming miniature polypi within the ducts. The particular tumour shown in *Fig.* 473 was remarkable not only for the mitotic figures within the epithelial cells, but also because of a barrier of lymphoid tissue which separated the deeper cells from the muscularis mucosæ, in which also mitotic figures were plentiful (*Fig.* 474). Mitotic figures are only very rarely found in the epithelial cells of adenomata surrounding a cancer.

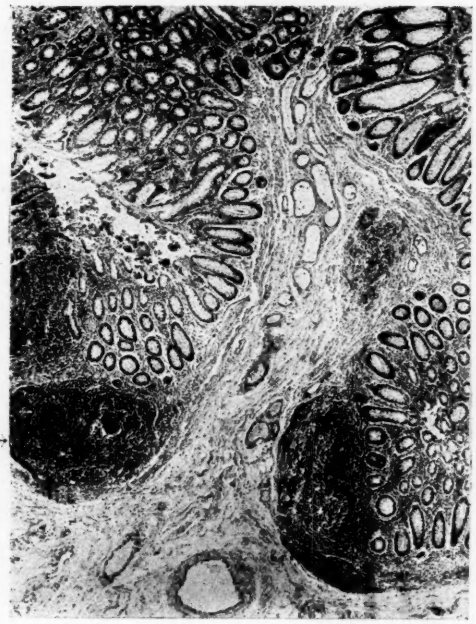
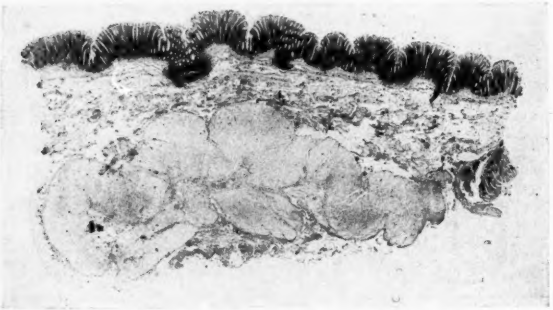


FIG. 469.—A higher magnification of the same slide from which *Fig.* 468 was taken, to show cap of lymphoid tissue (A) covering inward folds of mucous membrane. (× 24.)

From the point of view of the relationship of benign to malignant tumours of the bowel, a question of paramount importance is the order in which these growths appear: did the simple tumours precede the cancer or have they developed subsequent to the malignant growth? Some indirect

FIG. 470.—Section through another tumour from the same case. Note cystic dilatation of the glands, 'collar catarrh', and great increase of lymphoid tissue. A, 'Collar catarrh'; B, Adenoma; C, Lymphoid follicle. (*M.A.* 3.) (× 8.)

FIG. 471.—Section through a portion of the mucous membrane of the rectum in a case of cancer of the rectum accompanied by six small adenomata within three inches of the cancer. Note 'switchback appearance' of the mucous membrane, which here bears no tumours visible to the naked eye. (*M.A.* 11.) (× 4.)



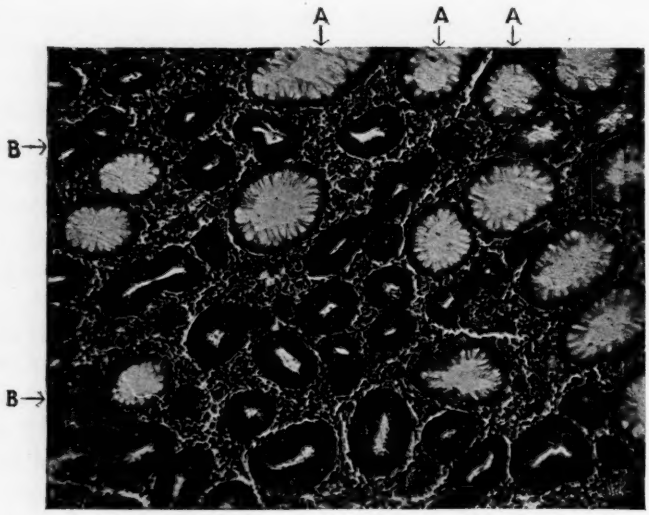


FIG. 472.—Transverse section through one of the six simple tumours in same case as *Fig.* 471. Note that some cells are secreting mucus (A) and others are not (B). (*M.A.* 11.) (× 90.)

evidence on this question of seniority can be obtained from a consideration of the general structure of adenomata and the morphology of the constituent cells. A firm pedunculated adenoma, the cells of which are vigorously secreting mucus, has had time to consolidate its position and cannot be regarded as a very recent growth. Cells exhibiting many mitotic figures, on the other hand, indicate a district where rapid growth of the tumour continued to the moment of extirpation. Intermediate in age between the cells undergoing mitosis and the goblet cells loaded with mucus we can recognize the type of cell with large deeply-staining nucleus not secreting any mucus at all.

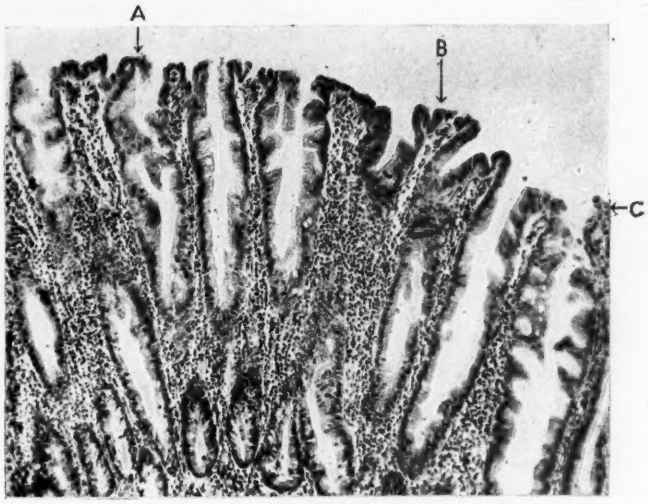


FIG. 473.—Section through a small area of epithelium, growing rapidly and just commencing to form a small tumour, situated close to a cancer of the rectum. The epithelial cells were not secreting mucus and showed numerous mitotic figures. Note pleating (B) and stratification (A) of the epithelium and formation of miniature interglandular polypi (C). A barrier of lymphoid tissue (*see Fig.* 474) separated the deeper cells from the submucosa. (*M.A.* 14.) (× 75.)

Information gained from the morphology and behaviour of the cell cannot, of course, fix the age of the tumour exactly, but it permits of a rough classification into tumours still actively growing, indicated by mitotic figures; tumours in which growth has recently occurred but is not now taking place, indicated by cells with large deeply-staining nuclei; and mature adenomata whose cells resemble the neighbouring mucous membrane both in form and function. When these tests are applied to the adenomata which accompany cancer of the rectum and sigmoid we find that most of the adenomata consist of a mixture of cells some of which are secreting mucus and others not (*Fig.* 472). Glands lined with cells actively secreting mucus adjoin other tubes lined with

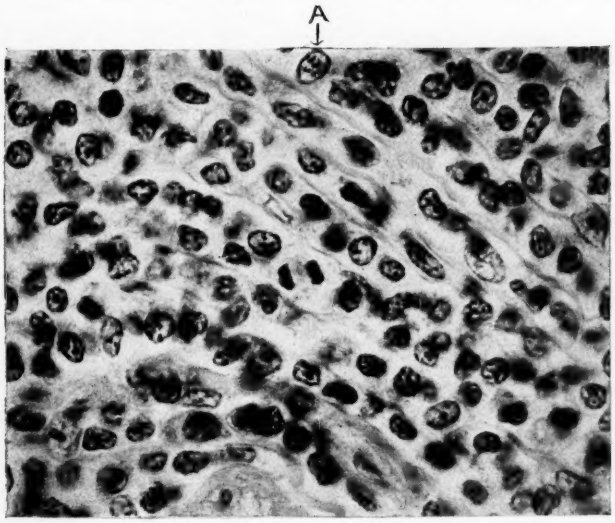


FIG. 474.—Section through barrier of lymphoid tissue beneath rapidly growing epithelium shown in *Fig.* 473. Note mitotic figures in lymphoid cells in centre of photograph in the direction indicated by A. (*M.A.* 14.) (× 665.)

closely packed mucus-free cells, distinguished by large deeply-staining nuclei. In such tumours mitotic figures cannot be found, and the cells appear to have passed beyond the initial stage of lively growth and are now commencing to accommodate themselves to their appropriate function. Well-established predunculated polypi, on the other hand, are usually covered with a layer of cells all actively secreting mucus. Tumours that are composed entirely of non-mucus-secreting cells are very rare, and as for mitotic figures, these are practically never found.

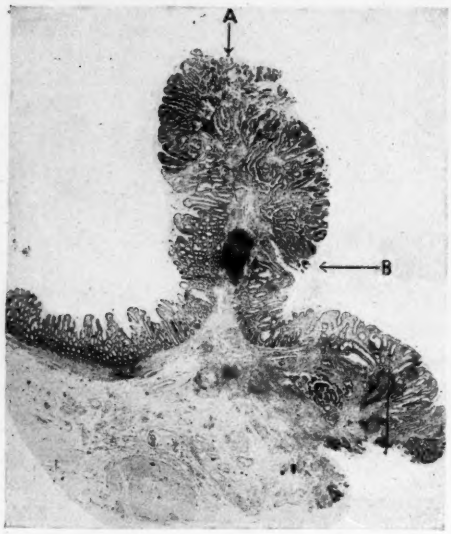


FIG. 475.—A polypoid adenoma situated close to a large ulcerating cancer of the rectum, but separated from it by an inch of normal mucous membrane. Other smaller adenomata were also present. The cells at the tip of this tumour had undergone cancerous degeneration (A) (*see Fig.* 476); B, Lymphoid follicle in stalk of tumour (dark mass). (*M.A.* 9.) (× 6.)

This evidence may be summarized by saying that most of the simple tumours surrounding a cancer have passed beyond the initial stage of lively growth, and that in the non-pedunculated tumours some of the epithelial cells are beginning to secrete and others are already at work secreting mucus, and that well established pedunculated adenomata are also common round a cancer.

3. THE INTIMATE STRUCTURE OF EARLY ADENOCARCINOMATA.

The majority of cancers of the large bowel removed by operation have the character of large projecting masses, or shallow ulcers with raised edges. Because of the general confusion caused by the irregular growth, and also because of infection with bacteria of the fæces leading to inflammatory reaction, little can be learnt from these mature tumours about the initial architecture of the growth. Very early cancers, however, provide instructive material for study, and two of the cases in this series came within that category.

FIG. 476.—A higher magnification of the tip of the polypoid adenoma illustrated in *Fig.* 475, to show onset of cancer at tip. (× 135.)

Fig. 475 represents a large pedunculated adenoma situated above an ulcerating cancer of the rectum and separated from it by an inch of normal mucous membrane. Other smaller adenomata were also found round about, but this tumour was of special interest because it had already undergone malignant degeneration at the tip, as shown by *Fig.* 476. Though cancerous

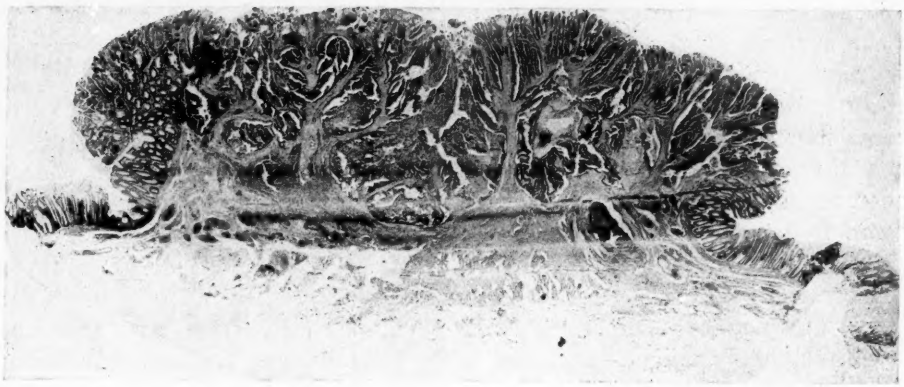


FIG. 477.—A complete section through a very early cancer of the rectum, which measured only 1 cm. in its broadest diameter and projected like a little button about 3 mm. above the surface of the bowel. Four small non-pedunculated adenomata were found within a radius of two inches of the growth. (*M.A.* 6.) (× 8.)

at the tip, the mucous membrane covering the neck of the polyp showed no evidence of cancer. Obviously this was an instance of cancer developing in an established benign adenoma. Similar cases to this have been described and illustrated by Dr. Verse.[1]

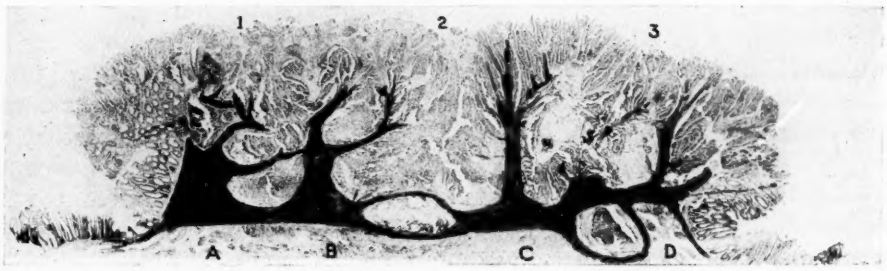


FIG. 478.—The same section as *Fig.* 477. Whilst the slide was under the microscope the supporting tissue in the photograph was painted a deeper colour, thereby emphasizing the fact that essentially the cancer has the structure of four adjacent pedunculated tumours, A, B, C, and D, between which the cancer cells have penetrated to their greatest depth. On the surface at the points marked 1, 2, and 3, the slight depressions may represent the original clefts between the adjacent tumours. (× 8.)

Fig. 477 is an enlargement of a complete section through the middle of a very early cancer of the rectum. The tumour measured only 1 cm. in its broadest diameter, and projected like a little button about 3 mm. above the surface of the bowel. Four small non-pedunculated adenomata were found within a radius of two inches of the growth. Serial sections were cut

through the entire cancer and underlying bowel wall, and the general architecture of the tumour was reconstructed from these. In its central part the tumour consisted of four stout trunks of stroma rising from a thickened base. Whilst the slide was under the microscope this supporting tissue was painted a deeper colour, as in *Fig.* 478, thereby emphasizing the fact that essentially the cancer has the structure of four adjacent independent tumours, A, B, C and D, between which the cancer cells have penetrated to their greatest depth. On the surface, at the points marked 1, 2, and 3, the slight depressions may represent the original clefts between the adjacent tumours. I have already referred to the fact that a simple adenoma of the rectum may later become surrounded by a circle of secondary tumours (*see Figs.* 465, 466), and if the district of increased epithelial growth affects an area greater than can be compensated for by forward bulging, then the mucous membrane must become folded on itself (*see Figs.* 467, 468). With these considerations in mind I formed the conclusion that the cancer represented in *Figs.* 477 and 478 arose from one of the many adenomata scattered over the mucous membrane. The primary tumour became surrounded by secondary adenomata. Later, malignant changes developed in the cells between the adjacent tumours, which, because of their position, were restricted in their growth and suffered from 'collar catarrh'.

GENERAL CONCLUSIONS.

This study of simple and malignant tumours of the large bowel brings the pathology of cancer of this region into line with recent views as to the early stages of cancer in other regions of the body, such as the views of Sir Lenthal Cheatle on the early stages of cancer of the breast.[2]

Strong support for the view that cancers of the bowel develop in preceding simple adenomata is offered by recent experimental work on the production of tar cancer in mice. Dr. J. A. Murray's[3] experimental researches have shown that, after painting the skin of laboratory animals with tar, tumour growth begins in isolated, usually minute areas, and not diffusely through the whole zone of application of tar. Dr. H. T. Deelman[4] observed that after about three months' regular application of tar to the shaved skin of mice a crop of little tumours arose, almost without exception, on the painted area. These varied in number from three to twenty and were generally between one and two millimetres in diameter; some remained small, and others developed to pedunculated papillomata. Judging from the series of photographs of these little tumours with which Dr. Deelman's article is illustrated, it would seem that these experimental tumours are identical in appearance with the simple adenomata which accompany a cancer of the bowel. Cancerous degeneration overtook one or other of these experimental simple tumours usually between six and ten weeks after the scattered irregularities of the painted surface were first noticed; after the cancer had developed the remaining simple tumours progressed no further.

With the experience gained from tar cancer as a guide we can figure the order of events in the development of a cancer of the rectum as follows. The first effect of the carcinogenic agent is that the epithelial cells of the mucous

membrane covering an extensive area of the bowel are stimulated to more vigorous growth *in many separated spots*, a state of affairs which may be recognized microscopically even before irregularity of contour can be distinguished by the naked eye. Later, *a crop of adenomata arise from this sensitive field* and some of these become surrounded by secondary tumours. The mucous membrane in the clefts between primary and secondary tumours is hampered in its growth and becomes folded inwards (*see Figs.* 465–469). Possibly these dislocated cells are the first to undergo malignant changes. But whether this be so or not, there is no doubt that the cells in the space between primary and secondary tumours are mechanically irritated, for in the condition I have called ' collar catarrh ' there is abundant evidence of chronic irritation.

Why cancer develops is an extremely interesting but rather unprofitable question for speculation in the present state of our ignorance. But to the questions *when* and *where* I hope these studies have made some contribution, for they have led me to the conclusion that cancer makes its appearance when a crop of simple tumours has arisen in the irritated field, and in close association with one of these.

Part of the expense of this research was met by a grant from the British Empire Cancer Campaign. I wish to thank the following pathologists for their kindness in providing me with material for study: Dr. Barnard, of University College Hospital; Dr. Baker, of the Middlesex Hospital; and Dr. Fry, of the Cancer Hospital. I am also under a special obligation to Mr. Lockhart-Mummery, Senior Surgeon to St. Mark's Hospital, for his interest in my work, and for the opportunity of consulting his opinion on several questions.

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REPORT OF A CASE OF SOLITARY FIBROCYSTIC DISEASE OF THE HUMERUS EXHIBITING SPONTANEOUS RESOLUTION: WITH A REVIEW OF THE LITERATURE AND A CONSIDERATION OF THE ETIOLOGY AND TREATMENT.

A. WILFRID ADAMS, BRISTOL.

RARE as it is, this malady has many claims on our interest. Commonly it declares itself in dramatic and forcible fashion by spontaneous fracture, suggestive of malignant disease of bone, but happily having its own unique radiographic picture. It is very amenable to operative treatment, and, indeed, may cure itself unaided if given the chance. It was this surprising finale in the case about to be recorded that led to a search of the literature and to the suggestion of factors concerned with the etiology of fibrocystic disease of bone.

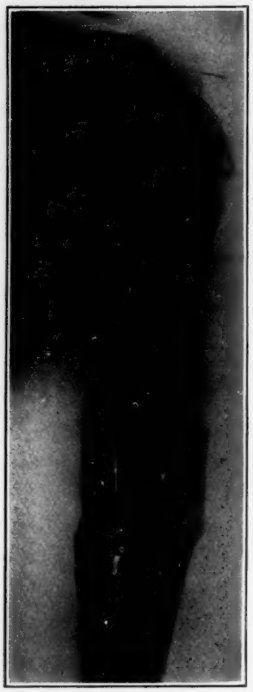

FIG. 479.—K. R. Fibrocystic disease of humerus (January, 1924).

CASE REPORT.

In January, 1924, K. R., age 13 years, had pain and weakness in his right arm following a slight injury at play a few days previously. Crepitus was obtained near the upper end of the right humerus and some thickening of the shaft detected, but no bruise or deformity was present. The skiagram (*Fig.* 479) affords a good example of fibrocystic disease. A pathological fracture is to be seen in it as a transverse crack across the upper segment of the humerus, which is markedly expanded. The cortex of the bone is only a thin shell, while the enlarged medulla is decalcified and cystic. Although so near the epiphyseal line, the disease has nowhere strayed across it, but is confined to the metaphysis. The usual treatment for fracture of the humerus resulted in union, and, after two months, the boy was fitted with a light leather support allowing full shoulder movements. However, a trifling injury fractured the bone again higher up. It united, only to be refractured for the third and last time within four months. The fragments fused satisfactorily, but in the presence of such fragility eradication of the disease was considered necessary. His admission into hospital was unavoidably delayed. This proved beneficial, for a radiogram in October, 1924, showed shrinkage of the medulla and re-formation of the normal cortex. In view of this propitious change in the train of events, operation became unnecessary. *Fig.* 480 (January, 1925) shows the next step towards spontaneous resolution, and in *Fig.* 481 (December, 1925) the bone is once more perfectly strong. No sort of medicinal treatment was used, but only splintage and massage in the early stages. At the present time, January, 1926, he has discarded the light leather support and has full power and unrestricted use of his arm.

Examination of the rest of the skeleton has revealed no other focus. The Wassermann reaction is negative. His own and his family history are healthy.

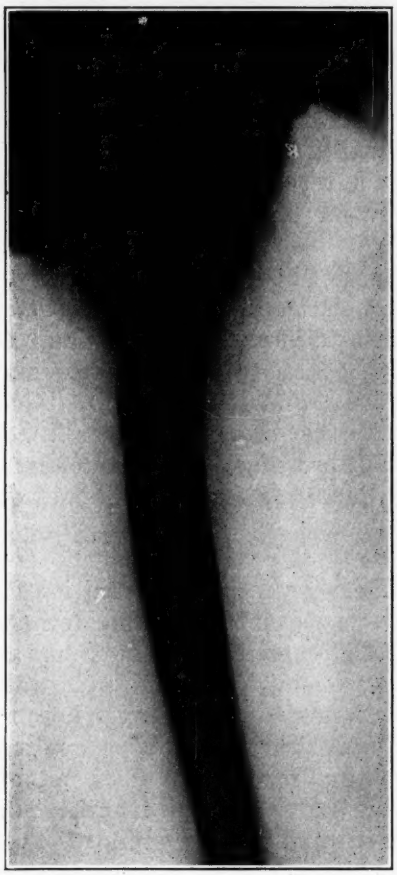

FIG. 480.—K. R. Fibrocystic disease of humerus (January, 1925).

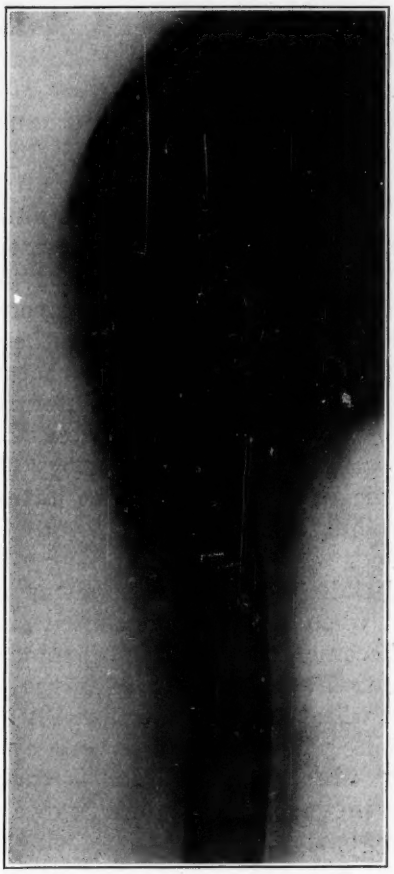

FIG. 481.—K. R. Fibrocystic disease of humerus (December, 1925).

GENERAL OBSERVATIONS.

Pathology.—Before discussing its etiology, a clear view of the structural changes found in this disease is desirable. It is notable that, as in many osseous disorders, there is a tendency for fibrocystic disease to affect the skeleton in three degrees. Thus it may involve one or many bones, or give rise to a diffuse affection of the whole osseous system. Like the common cancellous exostosis, it is usually a solitary lesion at the end of one of the long bones, and so contrasts sharply with a disease such as osteitis deformans, where a widespread affection of the whole skeleton is the rule. In this contribution interest is focused on the solitary simple fibrocystic lesion.

As no operation was performed in the case here recorded, the histological report so clearly given by Silver[1] on the morbid material derived from his own allied case is quoted as concise and typical :—

" The bone trabeculæ . . . are separated by a fibrogranulomatous tissue

consisting of long and short spindle-shaped cells. . . . The bone trabeculæ are lined with one or more layers of osteoblasts and in some places are groups of osteoblasts". The fibrocystic area occupies the medulla of the bone. It is lined by membrane in some cases, and may contain, in addition to the common fibrous and fluid elements, cartilaginous, bony, myelomatous, or even sarcomatous tissues. As the cyst expands and causes absorption of the cortical bone, a pathological fracture is a common complication, and incidentally the reason for which the patient usually first seeks the doctor. The clinical records of these cases often contain recurrent fractures and stretch over a long period of years, until finally an operation such as thorough curettage exterminates the disease.

During the history of fibrocystic swellings of bones much has been written on its relationship to other osseous dystrophies, and this received attention recently from Dawson and Struthers,[2] who state in their monograph: "There is good reason for believing that the pathogenesis of rickets, osteomalacia, osteitis fibrosa and osteitis deformans is allied, and it is recognized that the pathological conceptions of these diseases pass over into one another". Indeed, they consider that the histology of osteitis fibrosa and osteitis deformans is 'identical', but note that the latter occurs later in life and the bones do not break but bend.

Etiology.—The disease seems to have been given public definition first in 1891, when von Recklinghausen gave a description of the diffuse form which has become classical. He pronounced it an inflammatory lesion. Spontaneous resolution such as occurred in the present case would be compatible with this view, whilst on the other hand it certainly seems to negative Virchow's older teaching which attributed bone cysts to cystic degeneration in chondromata. If the fibrocystic condition is an inflammatory reaction, it does not appear to be provoked by a stimulus of an infective nature, for no mention is made of any bacterium or parasite being found in any of the cases in all the records at my disposal. Staphylococci were present in one of the cases of tibial cyst reported by Elmslie,[3] but were regarded as due to skin contamination. Certainly from the skiagraphic standpoint one does not associate with infective osteitis the very smooth, thin, and sharply-defined bony shell which typifies bone cyst. Lubarsh and Rabke are quoted by Young and Cooperman,[4] writing on the diffuse disease, as protagonists of the infective theory, but Morton[5] in discussing etiology states that the condition is certainly not due to any of the ordinary bacteria. Lawford Knaggs[6] argues in favour of osteitis fibrosa, osteitis deformans, and osteomalacia being reactions of different degrees to the action of toxins on the skeleton.

Evidence in favour of the endocrine origin of the disease is weighty and growing. Young and Cooperman[4] refer to Boit's view that the changes in the bones result from toxic, metabolic, or infectious processes, and also derangements of internal secretions. Morton[5] quotes cases of an associated parathyroid tumour having been found by Meyer in one case and similar findings by Schmorl in closely related forms of disease, adding that Meyer thought it accidental. The most tangible support comes from the case of multiple fibrocystic disease reported by Dawson and Struthers,[2] involving

gross decalcification of many bones and in which a parathyroid tumour the size of a cherry was found in addition to the natural representatives of that gland. Their case was accompanied by a pathological deposit of calcium salts in the muscles, and they conclude their discussion on the etiology of osteitis fibrosa with the words, "The association of parathyroid abnormality with two extreme instances of calcium metabolic disorder is very suggestive of an endocrine origin". The foregoing writers have been concerned, it appears, mainly with the multiple and diffuse varieties of the disease.

In the past trauma has figured sufficiently as the causative factor in this pathological process to merit reference. Von Mickulicz in 1904 opposed the inflammatory theory of von Recklinghausen by attributing these cysts of bone to a 'simple' disturbance of growth. Bloodgood[7] in 1910 expressed his opinion, "I therefore have been unable to find any definite etiological factor, and I cannot agree with those who look upon the lesion as the result of trauma, but it cannot be denied that there is some justification in considering the possibility of traumatism as a factor". Elmslie,[3] in reviewing the present situation (1914) on the nature of bone cysts, writes: ". . . and they have been recorded by Frankenheim in callus at the seat of a fracture". David Silver[1] in his remarks on etiology includes traumatic as the second of the theories given. He quotes the opinion of Beneke that bone cysts are analogous to apoplectic cysts of the brain, and notes that if they are simply localized osteitis fibrosa, then that in turn may itself own a traumatic origin. A memorable warning is sounded by Elmslie in this connection as follows: "Next to fracture, pain and swelling are the most frequent symptoms. These may arise spontaneously; more often they come on after an injury. Some observers have on this account ascribed a traumatic origin to the cysts. It appears more probable that the injury has caused an incomplete fracture through a pre-existing cyst, and that pain and swelling have resulted from further enlargement of the cavity". On these grounds one assumes the existence of a fibrocystic focus prior to the forcible twisting of the arm in Heath's[8] case. In 1922, Young and Cooperman[4] conclude that "traumatism does not cause the general form of this disease, although there is distinct evidence to show that local osteitis fibrosa and benign bone cysts are caused by trauma". Although the foregoing evidence is too slender a support on which to argue in favour of a violent origin for solitary fibrocystic disease, the writer feels that in the form of the repeated minor stresses of active life, the mechanical factor of force does appear to be a contributory exciting factor in the pathogeny of fibrocystic disease.

On investigating the site and age incidence of cysts in the solitary variety of the disease, one finds the bulk of the cases concentrated in a few regions of the skeleton, and that almost all of them start in youth. Bloodgood collected 57 cases of solitary true bone cysts, and states, without giving detailed statistics, that "benign bone cysts are found prominently in the humerus, femur, and tibia (in that order of frequency). More often they extend to the epiphyseal line, but there are cases in which the disease involves the centre of the shaft only". As to age, he asserts that "the disease with the rarest exceptions starts before twenty—that is, before complete ossification of the epiphysis". Silver gives figures, but does not specify the end of

the bone affected in his cases. He gives the order of frequency as femur, humerus, tibia. If we confine ourselves to the figures of Elmslie's cases in which alone the particular extremities are mentioned, we find these startling proportions :—

Humerus, upper end	21	= 35	per cent
,, lower end	3	= 5	,,
Femur, upper end	13	= 21	,,
,, lower end	10	= 16	,,
Tibia	7		
Other bones ..	5		
Total	59		

Four of his cases affecting the tibia in which the condition appears not quite typical have been omitted, leaving 59. If to these are added the case recorded by Heath and the present one, it merely emphasizes the striking preference of the disease for the upper end of the humerus and ends of the femur, where epiphyseal plates appear early, work late, and with great rapidity. Two factors combine to distinguish these sites—namely, marked cellular activity and great stress. First, it is at them that the most rapid deposition of bone takes place during growing years. Secondly, on them, too, unusual stresses fall owing to the transmission of rotary movements near ball-and-socket joints and the action of strong muscles of the great body-girdles pulling on the humerus and femur in all directions. Additionally, in the leg is the vertical pressure of body weight. How real is the rotary stress to which the bone-end is subjected is shown by the fact that nature guards against the tendency for the head of the humerus to twist round on the shaft by developing conical bosses at the upper end of the diaphysis on which the head of the bone is securely seated (*Fig.* 482). The vulnerable nature of the delicate formative tissues of this juxta-epiphyseal region is borne out by the frequency with which disease invades it in the early years of life—for example, in rickets, congenital syphilis, acute osteomyelitis, tuberculosis, and the cancellous exostoses.

The occasional mid-shaft position of fibrocystic disease calls for explanation, as it would seem at first sight to vitiate the argument that attributes its origin to the metaphysis. Its presence in the middle of the shaft is due to its displacement thither when the influence that provoked its formation has ceased to act, and the bone-cell factory at the epiphyseal line has resumed the supply of healthy bone. Thus, in its mode of origin and subsequent fate it may be compared helpfully with the transverse markings visible in the finger-nails of some patients after a debilitating illness. The actual site of formation of this defective zone in the nail is up under the cuticle, but it migrates distally with the passage of time (owing to the continuous proliferation of nail proximal to it). In the series of skiagrams of the cases of E. O. and C. R. reported by Elmslie we actually see this migration from one end down the shaft of the bone taking place in the humerus. The skiagrams were taken over a period of three to four years. In fact it would seem that from the number of centimetres between the bone-end and the site of disease, the age of the patient when the metaphysis was attacked might be deduced;

but because the disease happens to occupy a diaphyseal situation when detected, it must not be taken to mean that it has always been so.

If it be granted, then, that trauma, in the sense of the constantly repeated stresses natural to the wielding of limbs, is the exciting cause and that the site of incidence is where stresses fall most on young metaphysial tissues, there still remains for explanation the rare occurrence of the disease.

From the foregoing review of the literature of this subject one is led to attribute the malign influence predisposing to fibrocystic metaplasia of bone tissue to error in the functions of the parathyroid glands, which are known to be

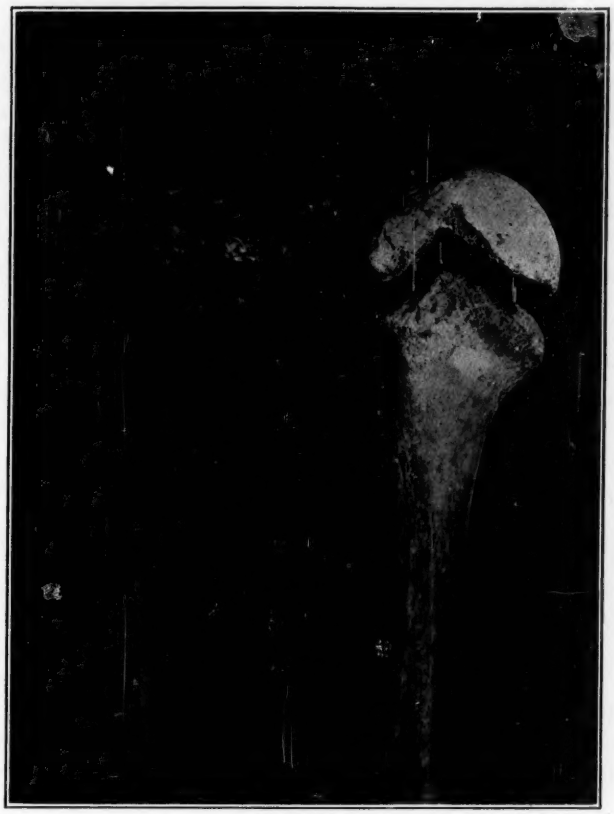

FIG. 482.—Two humeri prepared to show the concavity of the head epiphysis fitting the diaphyseal bosses.

closely associated with calcium metabolism. The vulnerable tissue at the metaphysis may be compared with gunpowder, and the physical stresses to which it is exposed are like sparks. Normally the two associate, but are insured against interaction and explosion by the damping effect of the parathyroid secretion. If this damper is defective, the inevitable conflagration follows and smoulders until it is cleared away by the surgeon or until an adequate supply of parathyroid secretion overcomes the flames and allows internal reconstruction to take place. This weakness on the part of the parathyroid secretion manifests itself in various grades, and may be transient or persistent. In mild

cases—for example, when a solitary fibrocystic lesion develops—it is probable that the covering influence of the parathyroid gland is barely adequate, so that at some juncture in a vulnerable area like the shoulder, knee, or hip exposed to heavy mechanical stresses, the previously latent inadequacy becomes manifest in disorganization of calcification, and a segment of bone is turned out defectively until the healthy balance of internal secretion is restored and subsequent metaphysial additions are normal. The zone of fibrocystic disease is a monument to a period of defective calcification at a certain time in an individual's growth.

These faults in the bony strata may happen more often than we suspect, in some cases giving rise to slight or even no symptoms at all, and disappearing, leaving no trace. The reports of the disease at my disposal show that the fibrocystic focus tends to persist and demands for its cure a thorough removal by curettage. This is not always so, however, and from the following facts it is fair to deduce that the underlying causal condition may act only temporarily, and then give place to an overcoming corrective influence. Silver records 6 instances of spontaneous cures, and, in the discussion following his paper, Dr. Colvin reported another, which with my own patient (K. R.) makes a total of 8 such cases. Thus among some 200 cases of monosseous fibrocystic disease about which I have information, apparently 4 per cent healed without surgical intervention. This agreeable feature allies the disease with another disorder of bone—namely, rickets. Apparently when in fibrocystic disease the parathyroid function regains its healthy level it may resume its covering influence on the affected osseous tissues. As a result the disorder in the metaphysis disappears and the cells 'harden' to withstand the physical stress they are normally called upon to bear. Fibrocystic disease seems to form one of the many guises in which defective calcium metabolism manifests itself. The phasic variation in the stability of body calcium is one of the great romances of physiology, seen in such conditions as fragilitas ossium, rickets, tetany, dental caries of adolescence and pregnancy, osteomalacia, and osteitis deformans of later life.

Treatment.—Finally a word is called for in connection with treatment on which the foregoing observations have a bearing. The treatment of curettage without bone-grafting advocated by Bloodgood does not appear to have been surpassed, but before deciding to operate one should not forget the historic evidence of cures that have occurred by mere external support and restrained movement continued for a sufficient length of time. The possible benefit of concurrent parathyroid feeding calls for consideration.

SUMMARY.

1. Three factors enter into the etiology of fibrocystic disease: (*a*) Vulnerable formative tissues of the metaphysis, especially at the upper end of the humerus and the extremities of the femur; (*b*) The site of maximum physical stress on bones—that is, near the shoulder, hip, and knee where strong muscles pull and twist; (*c*) Instability of calcium control owing to defective parathyroid function.

2. The varying degree to which the skeleton is affected by fibrocystic disease admits of easy explanation. Thus in the mildest cases there will be a temporary disorder affecting one of the particularly susceptible regions—for example, the upper end of the humerus—and subsequent disappearance of the disease; in a moderate deficiency of parathyroid function a solitary lesion occurs and will persist; while in a severe disturbance multiple foci would manifest themselves; and finally the diffusion of the disease throughout all the bones (von Recklinghausen's disease of bones) may be regarded as a malignant form.

3. In the monosseous type of fibrocystic disease of bone spontaneous cure has only been known to occur in about 4 per cent of cases. It remains to be seen whether this percentage can be augmented by the wider adoption of palliative treatment.

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FAT NECROSIS OF THE BREAST, WITH AN ACCOUNT OF A CASE.

By GEOFFREY HADFIELD, Bristol.

Inflammatory processes in breast fat are frequently encountered in the routine examination of excised breast tissue. In the large majority of cases the gross and microscopic characters of the process are identical with those found in inflamed fat in other situations. In a few cases, however, when the injurious agent is trauma inflicted locally on a pendulous breast heavily loaded with fat, a circumscribed lesion may arise which bears a striking naked-eye resemblance to cancer, and may present several of the classical signs. Lee and Adair[1] first drew attention to this innocent condition in 1920, and they have now published five cases. One case has been reported by Keynes,[2] and Rowntree[3] has described one almost certainly of the same nature. Of these seven cases, four so closely resembled breast cancer that needless amputation was performed. Trauma appears to be an essential factor in the causation, a history of trauma being definite and exact, whilst its site and the location of the lesion are identical. The lesion in that stage of its evolution when it resembles cancer is hard and often adherent to the skin, sufficiently so to produce dimpling and the 'peau d'orange' appearance. In the case here reported there were two small foci of fat necrosis which, although not resembling cancer sufficiently to justify total excision, were found to bear a close resemblance to it on naked-eye examination, and microscopically showed the early stage of the lesion before the deformity and contracture of fibrosis had masked its initial phase.

CASE REPORT.

History.—A woman, age 47, was admitted to hospital complaining that for the last four weeks the right breast had become painful and that a bruise-like area had appeared on its outer side. The pain was not continuous or severe, and she had felt no lump. A week before she noticed the pain a spade fell on the right breast, but the injury was slight. Her youngest child is 17; both her children were breast-fed for ten months. The breast was large, fatty, and pendulous. In the outer upper quadrant was a small, well-defined nodule which appeared to lie almost directly under the skin. It was not fixed above or below, and the skin over it was normal.

Operation (Mr. Duncan Wood).—A wedge-shaped piece of breast in the outer upper quadrant was excised. It consisted almost entirely of fat in which were two small nodules roughly circular in outline and half an inch in diameter, moderately hard and white, chalky and homogeneous in appearance. Radiating from the nodule in all directions were very fine chalky-white fasciculi. The lesions occupied the whole of a small lobule

of fat. They had produced no deformity or contracture and, except for the fine radiating fasciculi, gave the impression that a single fat lobule had become partially calcified *in situ*. Recovery was uneventful.

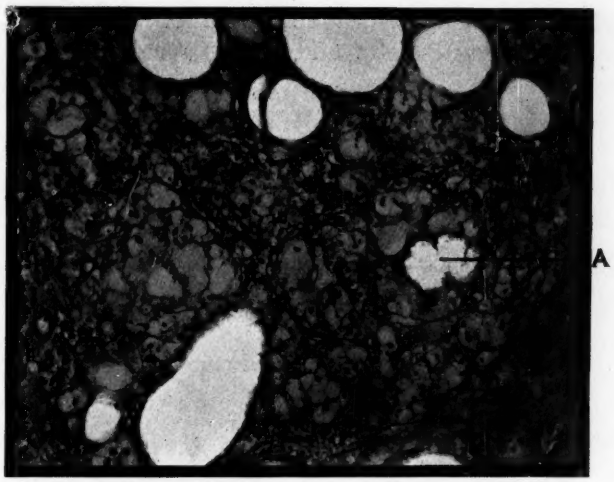

FIG. 483.—Microphotograph of centre of lesion. Uninjured fat globules widely separated by large foamy cells. At A a globule of fat is seen partially broken down and invaded by similar cells.

HISTOLOGICAL EXAMINATION.—Sections include the nodule, which lies entirely in the breast fat, two small ducts, and their related lobules. The latter are richly infiltrated by lymphocytic cells, but show little change

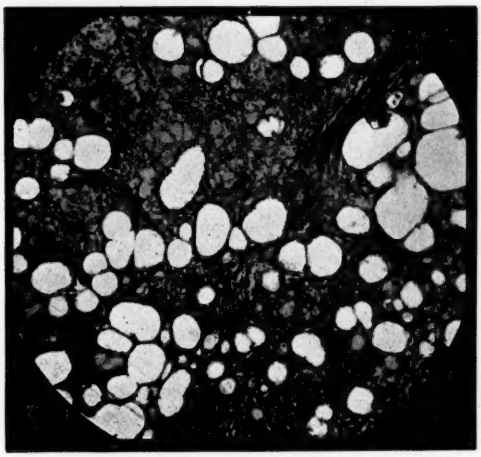

FIG. 484.—Low-power view of main mass of lesion. Uninjured globules widely separated by fat phagocytes.

beyond this. The nodule is composed of large swollen cells with foamy cytoplasm which lie between, distort, and widely separate unruptured fat globules. Its edge is fairly sharply defined, but thin fasciculi of foamy cells

spread into the surrounding fat in all directions. The lesion is almost bloodless. There is a mild fibroblastic reaction in the few connective-tissue septa which penetrate the lesion and in the neighbouring breast tissue. A few of the fat globules situated in the centre of the lesion are filled by faintly-staining material uniformly finely vacuolated or by similar material intersected by tiny cigar-shaped clefts and spaces recalling the appearance seen in such situations as the aorta where doubly-refractile cholesterol esters are deposited out of reach of living cells. In other places the outline of a fat globule can be seen, but its peripheral third is occupied by a circle of swollen cells with foamy cytoplasm and central, rather feebly staining nuclei, the whole giving the false impression of an alveolar formation. The outlines of other fat globules can only be faintly traced: these contain a central irregular finely-vacuolated mass closely invested by foamy cells, and in the centre of a few is a single multinucleated giant cell.

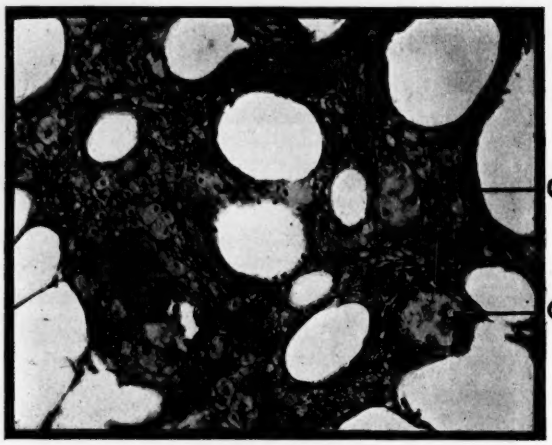

FIG. 485.—Similar changes to those seen in *Fig.* 483, with two unabsorbed globules, G1 and G2, still *in situ*.

The rest of the nodule is composed of unaltered fat globules and sheets of closely applied foamy cells, with a few scattered giant cells. Lymphocytic cells and normal leucocytes are absent in the centre of the lesion and scanty at its periphery, being confined almost entirely to the adjoining breast lobule. (*Figs.* 483–485)

COMMENT.

The lesion hardly raised the suspicion of carcinoma on clinical examination, chiefly because of its small size, superficial situation, and the absence of signs of adhesion, the latter due to its recent formation. It was, however, difficult to exclude malignancy with certainty on naked-eye examination of the excised tissue. It is unfortunately common to find a malignant mass much larger and usually harder. The uniformly opaque appearance on section was also atypical of carcinoma, but unless fat necrosis had been

borne in mind it would have been difficult to make any diagnosis other than malignant disease in an uncommonly early stage.

The other clinical particulars of the case—for example, the history of trauma and bruising and the pendulous fatty type of breast—agree with those of Lee and Adair's cases. This case illustrates the fact that fat necrosis produces a similar clinical picture to cancer only when a sufficient interval has elapsed for replacement-fibrosis to produce contracture.

As regards the histological characters of the lesion, there seems no reason to doubt that this case represents the early stage in the genesis of the more cicatrized lesions described by other authors. Its histology is very similar to that described by Keynes, but in his case the foamy cells had penetrated into a larger number of fat globules and the diagnosis by frozen sections was difficult. Keynes describes the predominant cell in the lesion as an embryonic fat cell. This appears to be rather confusing, as, although the cells taken singly are morphologically indistinguishable from the cells of developing adipose tissue, they are obviously functioning as fat phagocytes, probably of endothelial origin and accompanied by foreign-body giant cells. The myelin phagocytes or 'Gitterzellen' found in the central nervous system in disease are closely related cells. In this case the early stages in the absorption and invasion of an injured fat globule could be traced from the earliest phase when the fat was breaking up, but was not yet invaded by phagocytic cells, to the later phase when a mass of endothelial phagocytes entirely replaced it. Judging from the other published descriptions, the lesion then undergoes progressive fibrosis at its edge ; the central mass of fat phagocytes breaks up, leaving a cyst containing semi-fluid fat, surrounded by a zone of giant cells and walled in by fibrous tissue.

I am much indebted to Mr. Duncan Wood, Surgeon to the Bristol General Hospital, for permission to use his clinical records.

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SHORT NOTES OF RARE OR OBSCURE CASES

A PEDUNCULATED THYROID TUMOUR AT THE BASE OF THE TONGUE, ARISING FROM THE REGION OF THE FORAMEN CÆCUM.

By FRANK HARVEY, London.

Tumours consisting of thyroid tissue which grow at the base of the tongue are portions of the thyroglossal mass which develops from the hypoblast in the middle of the furrow that lies between the two elevations on the floor of the primitive pharynx, from which the buccal and pharyngeal parts of the

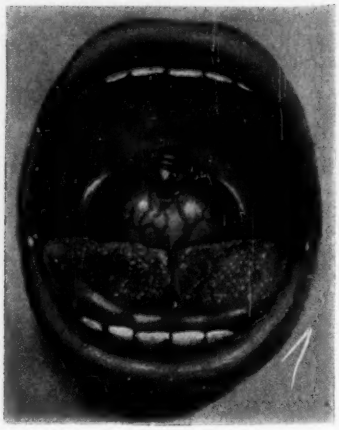

Fig. 486.—Thyroid tumour of the tongue.

Fig. 487.—Appearance of tumour with tongue held forwards.

tongue are formed.[1] These tumours are more often solid than cystic, consisting of vascular thyroid tissue of immature development. When growing in the region of the foramen cæcum they are generally sessile, and rarely pedunculated as in the case to be described.

History.—On July 2, 1924, I saw with Dr. Harold Greenish, of Fleet, Hants, a girl, age 26 years, who had had a severe hæmorrhage from the mouth on the previous day. The patient had complained to her parents for some months of difficulty in breathing and swallowing; but little

notice was taken of her complaints, owing to her being considered mentally deficient.

For two years thyroid extract had been given with good effect, but had been discontinued, as the patient became very troublesome and refused to take it, and the parents were apathetic. Menstruation commenced at 14 years, and is, at the present time, regular. The patient's parents are normal individuals, as are the other members of the family.

On Examination.—The girl is cretinoid, stunted in growth, being only 4 feet 4 inches in height, undeveloped mentally, talks and behaves like a child of eight or nine years of age. Skin and hair are normal. No thyroid gland is palpable.

Fig. 488.—Microscopical appearance of a section of the tumour. (×65.)

The patient was anæmic when I first examined her, from the hæmorrhage of the previous day. On looking inside the mouth a tumour could be seen lying at the back of the tongue nearly filling the space between the anterior pillars of the fauces and pushing the uvula forwards (*Fig.* 486). The tumour was mobile, about the size of a walnut, pinkish in colour, and with large blood-vessels coursing over it. By using a small laryngeal mirror it was possible to see the attachment of the tumour to the base of the tongue, which was by a short, thick pedicle, about a quarter of an inch in thickness. The epiglottis could not be seen. As the presence of the tumour was causing dyspnœa and dysphagia, and also because of the severe hæmorrhage that had occurred on the previous day, it was decided to remove it.

Operation, July 4, 1924.—The patient was given a general anæsthetic. A Doyen's gag was introduced and the tongue held forwards by a clip (*Fig.* 487). To avoid hæmorrhage two curved needles threaded with No. 2 catgut were passed under the pedicle. An elliptical incision was made with a scalpel and the tumour with its pedicle was removed. The sutures were tied and effectually controlled the hæmorrhage, which was not severe. Convalescence proved uneventful. The patient has taken thyroid extract since the operation eighteen months ago, with marked improvement in her mental condition.

Microscopical Examination (*Fig.* 488).—Dr. Cavendish Fletcher and Dr. H. A. Osborne kindly examined the tumour for me and reported as follows :—

"The specimen is a soft rounded mass about the size of a large walnut. It is dull-pink in colour and one section was found to be mainly solid with a small central lumen which on histological examination proved to be a false cyst due to free hæmorrhage and degeneration—a common occurrence in thyroid tumours. The solid portions of the tumour are composed of a cuboidal epithelium arranged in alveolar and tubular masses—sometimes solid but frequently displaying a central lumen. The stroma is of connective tissue—frequently hyaline—and there is a copious blood-supply. There is no definite colloid. The tumour is encapsuled and obviously an adenoma, resembling a thyroid fœtal adenoma."

I have looked through the literature of thyroid tumours in the region of the tongue, but have not found any reference to one with so definite a pedicle, and Sir James Berry, who has taken a kindly interest in the preparation of this paper, tells me he has never seen one.

CONCLUSIONS.

1. Islets of thyroid tissue met with along the course of the thyroglossal tract are portions of the thyroglossal mass which develops at the base of the tongue, and are probably left behind as that mass sinks down the neck to occupy the normal position of the thyroid gland.

2. These tumours are generally sessile and rarely pedunculated.

3. In the majority of cases operative procedures are contra-indicated, owing to the danger of inducing myxœdema. It is only when these tumours cause definite symptoms, such as severe dyspnœa and dysphagia, that operative treatment is called for.

Finally, I wish to acknowledge my indebtedness to Mr. Ralph Coyte for correcting the proofs of this paper, to Mr. Thornton Shiells for his beautiful drawings of the case, and Mr. Ford for his drawing of the microscopical section.

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APPENDIX 'PINNED' TO THE LIVER.

By WALTER W. GALBRAITH, Glasgow.

A male child, age 11, was admitted to the Royal Hospital for Sick Children, Glasgow, on Dec. 14, 1923. He was stated to have been in his normal health until Dec. 8, when he complained of headache and slight colicky abdominal pain. The pain was not severe, and he was able to go about; but on the next day he vomited once, and, as he still complained of pain, he was confined to bed and given a dose of castor oil, with the result that his bowel moved freely. On the succeeding days the abdominal pain, more severe and almost constant, became localized in the right upper quadrant and was aggravated by deep breathing.

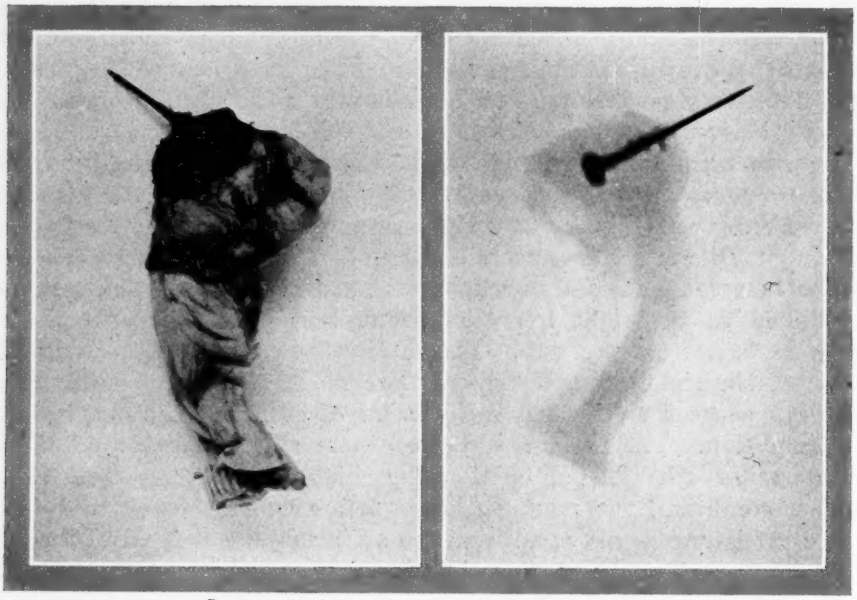
On Admission.—The patient looked very ill. The face was flushed, the respirations were rapid and shallow, and the alæ nasi moving. He stated that the pain was on the right side of the chest and the right upper quadrant of the abdomen, and was so severe that he was frightened to take a deep breath. There was a history of a right-sided pleurisy six months previously, and in infancy he suffered from anterior poliomyelitis affecting both legs.

Examination.—There was tenderness all over the abdomen, but rigidity was confined to the right hypochondrium, and over that area there was extreme tenderness on pressure. The respiratory murmur was diminished at the base of the right lung, but there were no adventitious sounds or other evidence to suggest an intrathoracic lesion of sufficient gravity to account for his condition. The heart sounds were normal. Temperature 102°, pulse 124, respirations 32. In our opinion the child was suffering from an acute abdominal condition, the most likely cause for which seemed to be inflammation of a high appendix resulting from an incomplete descent of the cæcum.

Operation.—Two hours after admission the abdomen was opened by a right rectus incision, and there was at once evident a fair amount of free fluid in the abdominal cavity, some of which was taken for culture. The cæcum was found raised out of the right iliac fossa and slightly pulled upwards by a tight band which lay on the anterior surface of the ascending colon. This band stretched from the normal site of the appendix to the under surface of the right lobe of the liver, to which it was firmly attached. Easily identified as the appendix, it was divided at its proximal end, the stump being ligated and buried in the usual manner. It was then dissected up towards the liver, its mesentery and one or two adhesions being divided. The whole appendix was now free except the tip, which was isolated from the general abdominal cavity by gauze packing and gradually freed by blunt dissection. The adhesion was dense, but it ultimately came away from the liver with a jerk. It was then seen that the difficulty in removing the appendix was due to a pin projecting from its tip and firmly fixed into the liver. There was no evidence of the presence of an abscess in the liver, but a tube was led to the surface from the puncture caused by the pin. The abdomen was closed in layers. After the operation the child recovered somewhat, and the temperature fell to 99°, pulse 108, and respirations 28; but three days later he

had a rigor, and the temperature rose to 102·8°, respirations 48, pulse 140. The face was flushed, and there was a faint icteric tinge, the breath being foul and smelling slightly of acetone. There was impairment of the percussion note and of the respiratory murmur at the right base. The general condition of the child was grave, and he died a few hours later.

Post-mortem Examination.—At the examination the next morning there was found a well-marked fibrinopurulent exudate throughout the abdominal cavity, the upper surface of the liver being covered with a thick layer. The liver itself was much enlarged, and on section it was found that rather more than the upper half of the right lobe was the seat of multiple



a *b*

Fig. 489.—*a*, The appendix with the corroded pin projecting from its lumen. *b*, Skiagram showing the calcareous deposit on the part of the pin within the lumen of the appendix.

confluent abscesses, some of which just reached the surface of the organ, and surrounding this area there was a zone of acute inflammation hæmorrhagic in appearance (*Fig.* 490). The remainder of the liver substance showed marked fatty degeneration. The spleen was enlarged and soft, and the kidneys were fatty and showed catarrhal changes. The lungs were acutely congested, and there were numerous petechial hæmorrhages on their surface. There was a diaphragmatic pleurisy on the right side. Fatty degeneration of the heart muscle was noted. No organisms either in film or on culture were found in the free fluid removed from the abdominal cavity at the operation. The appendix, which had been removed at the operation, was partially opened, when it was seen that the head of the pin was surrounded by calcareous deposit, and that there were numerous thread-worms within the lumen. The rest of the pin was corroded (*Fig.* 489).

Comments.—Cases of foreign body in the appendix are not rare, but

those with a pin in the appendix are not common. The above case, in which a pin became lodged in the appendix, and made its way to and perforated the tip, which it thereby fixed to the under surface of the liver, causing an abscess, must be one of extreme rarity, if not previously unrecorded. The child never

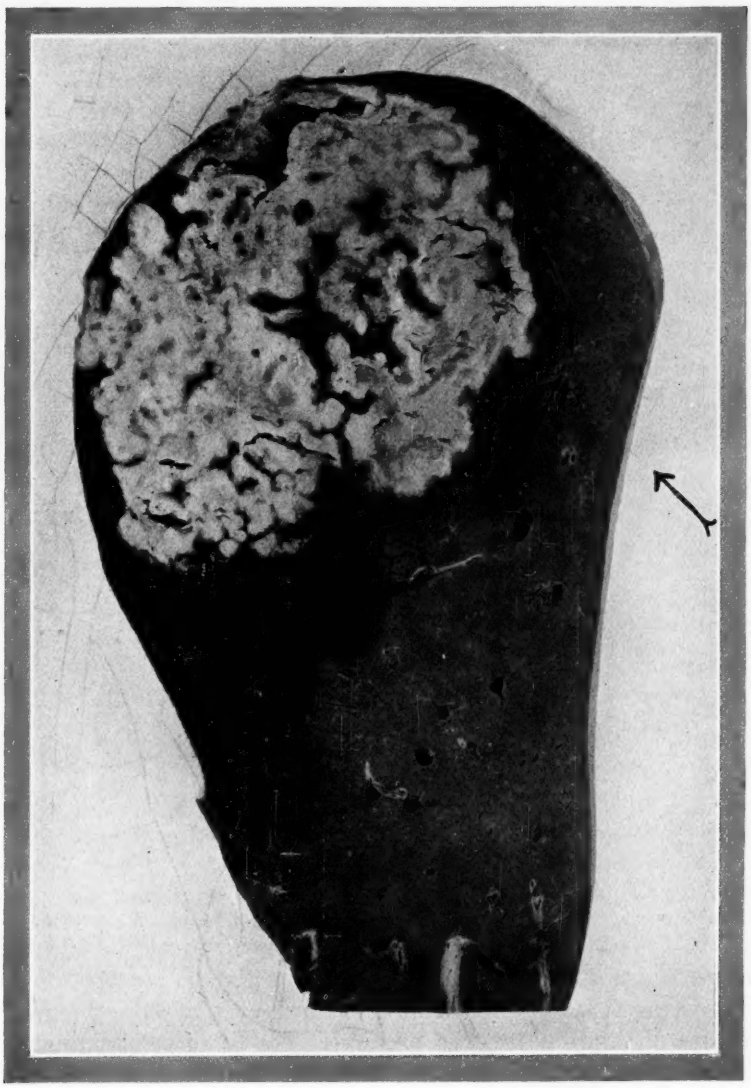


FIG. 490.—Shows a section of the liver (natural size), with confluent abscesses on the upper surface of the right lobe. The point where the pin was fixed, and its direction, is indicated by an arrow ; the track is not seen in this section.

remembered having swallowed a pin, and his mother could throw no light on the matter. The attack of pleurisy six months previously, which according to his doctor was a genuine attack, was probably an early manifestation of the presence of the pin in the liver substance.

A FIBROMATOUS TUMOUR CONTAINING OSTEOCLAST-LIKE CELLS GROWING IN THE SUBCUTANEOUS TISSUE.

By A. PINEY, London.

The description of the histology of neoplasms growing in unusual situations is often of value in throwing light on the origin of the growth. I have been unable to find any description of a tumour with the characters of a 'myeloid sarcoma' arising in the skin (Jores,[1] Kaufmann,[2] MacLeod[3]), but the present case seems to show that so surprising an event can occur.

The tumour was removed from the skin of the posterior fold of the axilla of a woman, about 35 years of age. The mass was of about $\frac{3}{4}$ in. diameter, and had caused both discoloration and puckering of the skin. On section

Fig. 491.—New-formed blood-vessel in the tumour mass. (× 500.)

Fig. 492.—Giant cell lying in the midst of fibroblastic stroma. (× 600.)

the growth was almost black, and was not sharply demarcated from the surrounding tissues. Some slightly enlarged axillary glands were also removed, but showed no change except the presence of a little ferruginous pigment.

The histological appearances varied somewhat in different parts of the growth, but the most striking feature was the presence of large amounts of dark-brown pigment, which gave the Prussian-blue reaction, i.e., was not melanin. The ground substance of the tumour was composed of active-looking fibrous tissue in which were a number of new-formed vessels with apparently incomplete walls (*Fig.* 491). There were a very large number of giant cells embedded in the fibrous ground substance (*Fig.* 492). These were extremely large elements with many nuclei, but there was no sign either of cell division or of nuclear activity. The giant cells were least numerous in

the places where pigment was most abundant, i.e., they were not collected around the foreign substance. The tissues most densely infiltrated with pigment were, in places, the seat of degeneration which had resulted in cyst formation (*Figs.* 493, 494). The characters of the tumour were practically identical with those of the 'myeloid sarcoma' of bone.

Professor M. J. Stewart, of Leeds, has kindly examined a section, and writes: "I must say that the giant cells in the central part of the tumour are extraordinarily like those of the benign myeloid tumour of bone, and not obviously foreign-body giant cells. . . ." He nevertheless says: "I do not think you will find many to agree with you that this should be called a myeloid sarcoma (of bone type)." It must be recalled that Professor Stewart holds that the 'myeloid sarcoma' of bone is a fibrous-tissue tumour derived from a specialized type of fibrous tissue, the peri- or endosteum of bone, which forms osteoclasts. The giant cells of 'myeloid sarcoma' are a continuation of these osteoclasts, which have become definitely neoplastic. He suggests,

FIG. 493.—General view of the tumour. At the bottom are seen small cysts containing pigment; on the top is the more cellular part of the mass, in which giant cells can just be detected. (× 50.)

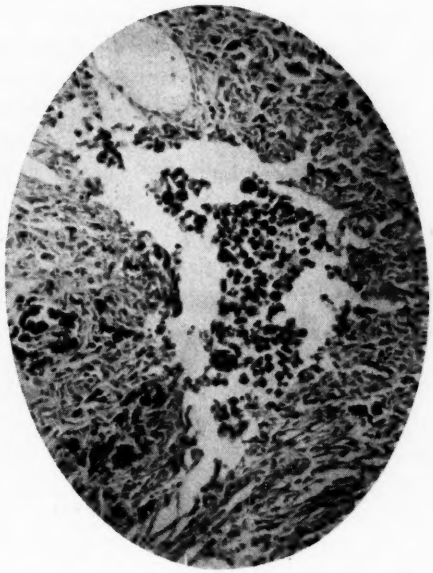


FIG. 494.—Cyst formation near the skin. (× 150.)

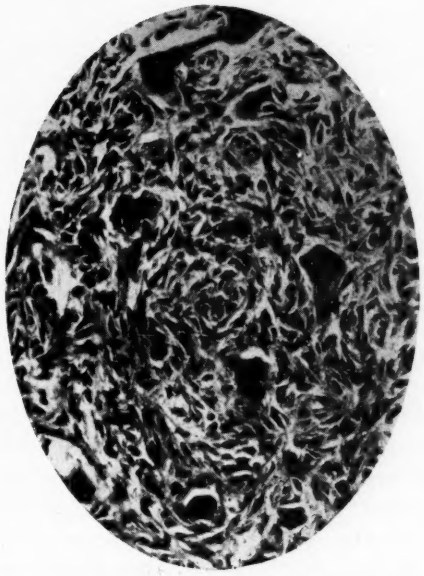


FIG. 495.—General view of that part of the tumour in which giant cells were plentiful. (× 120.)

in his letter to me, that it is possible that a somewhat similar condition might arise where there is fibrous-tissue reaction together with foreign-body giant cells, e.g., in the skin. He admits that this view would seem to be in favour of the conception of an endothelial origin of the giant cells, but he prefers to presume that they are of fibroblastic origin. If the large cells in the present tumour are really identical with those of 'myeloid sarcoma' of bone it would be essential to suppose that periosteum and endosteum are not very specialized forms of fibrous tissue, and therefore are not specifically able to give rise to this very special type of cell.

Mallory[4] has always supported the view that these tumours in bone represent no very specific type of neoplasm, but that the giant cells are nothing more than special differentiations of endothelial cells.

The very existence of such a tumour in the skin throws light upon the genesis of these neoplasms, which can no longer be so certainly regarded as derivatives of very specialized fibrous tissue.

Professor Mallory writes thus: "My diagnosis is a slowly growing type of capillary hæmangioma. As a result of injury there has been much hæmorrhage with hæmosiderin formation from it, and phagocytosis of the pigment by endothelial leucocytes with formation of numerous foreign-body giant cells (much more common with hæmatoidin crystals than with hæmosiderin granules)".

Parkes Weber has also suggested[5] that the tumour is of histiocytic origin.

I wish to thank Dr. J. M. H. MacLeod for the clinical information, and Mr. C. J. Marshall who removed the growth.

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SARCOMA OF THE SMALL INTESTINE IN A BOY OF THREE YEARS, ASSOCIATED WITH INTUSSUSCEPTION OF THE ILEUM.

By ANDREW FULLERTON, C.B., C.M.G., Belfast.

A boy, age 3 years, was admitted to the Belfast Hospital for Sick Children, on May 15, 1925, with the following history: Up to six days before admission he had been in good health. He then began to suffer from crampy pains in his abdomen, with vomiting and absolute constipation.

On Admission.—The patient complained of pains all over the abdomen, which was tender on palpation, slightly distended, and hyper-resonant. There was no rigidity, and no tumour could be detected either on abdominal palpation or per rectum. An enema was given with a fair result. The urine was acid, sp. gr. 1020, free from albumin and sugar, but gave the reactions for diacetic acid. Pulse 120, temperature 98°, respirations 30.

I saw the boy on the morning of the 16th. Notwithstanding the fact that an enema had had some effect in clearing his bowels, the abdomen was distended and tympanitic, and the patient continued to vomit. The vomiting was propulsive in character, and occurred immediately after his feeds. There was no fæcal odour from the vomited matter.

Operation.—On the same day the abdomen was opened by a right paramedian incision below the umbilicus. On opening the peritoneal cavity, free fluid escaped. An entero-enteric intussusception in the lower ileum was found, about a foot in length. This was reduced with comparative ease, disclosing at the apex a growth situated at the mesenteric border of the intestine (*Fig.* 496, A). The gut was distended above the growth and partially collapsed below. The segment containing the growth was removed, and the continuity of the bowel was restored by an end-to-end anastomosis, using two rows of fine catgut suture. On further examination a thickened area was discovered about a foot distal to the tumour, again occupying the mesenteric border. The condition of the child did not permit of further interference. The mesenteric glands were enlarged over a wide area. The abdomen was closed in layers without drainage. The child was discharged on June 6, looking fit and well.

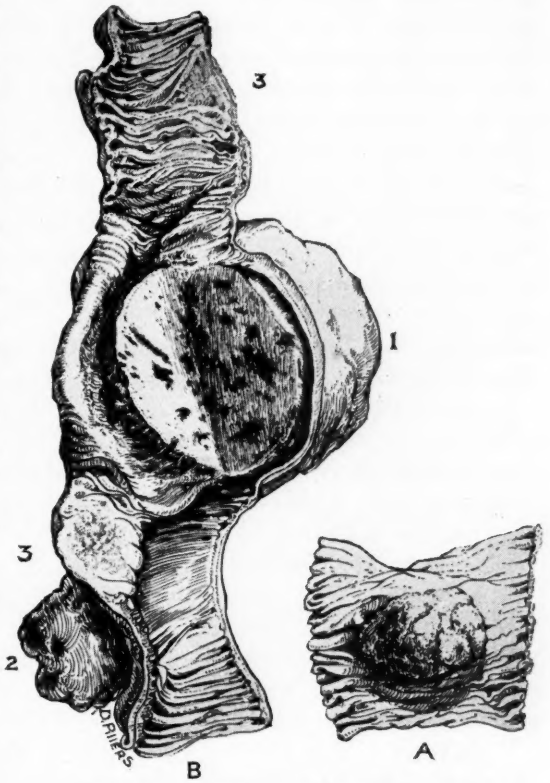

Fig. 496.—A, Segment of bowel removed at first operation, showing growth involving mucous membrane. B, Segment of bowel removed at second operation, showing growths at 1 and 2 and Peyer's patches at 3. The growth at 1 projects well into the lumen of the bowel; that at 2 is in the mesentery at its junction with the bowel.

On examination of the excised portion of intestine, the wall at the site of the growth showed a dimple on its peritoneal aspect, surrounded by a hard margin. The gut, on being slit up, exposed a firm swelling about the size of a walnut, projecting into the lumen. The intestinal surface of the growth was sloughy and foul-smelling. On section the tumour was whitish in colour and firm in consistence. On microscopical examination by Professor Symmers it proved to be a round-celled sarcoma.

The patient attended at the out-patient department from his discharge till July 11, when I again examined him. He looked well, but complained of colicky pains in his bowels. On palpation a hard lump could be felt to the right of and below the umbilicus. This was freely movable, rounded in shape, and appeared to be about the size of a small apple. Bimanually, the

tumour could be felt and pushed about quite freely in the peritoneal cavity. At the urgent request of his mother, the patient was readmitted to the wards on July 15, though it was felt that any treatment that could be carried out would be only palliative.

SECOND OPERATION.—On July 18 the abdomen was again opened, by an incision close to the scar of the previous one. A search was first made for evidence of the former operation on the ileum. The junction was discovered with difficulty, the site of the anastomosis being represented by only a very thin white line. There were no adhesions and no constriction of the gut. About a foot distal to this, and a foot proximal to the ileocæcal junction, a large growth was found (*Fig.* 496, B). This was evidently the thickened area seen at the former operation, which had greatly increased in size during the two months intervening, measuring now $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. It projected into the lumen of the gut from the mesenteric border. The affected segment of bowel was removed and an end-to-end anastomosis carried out. A number of small areas of thickening, evidently new growth, were found, all at the mesenteric border, reaching as far up as the duodenojejunal junction. The mesenteric glands were much enlarged. The vessels of the mesentery, more especially the veins, were engorged. The large intestine, the liver, spleen, stomach, and bladder were examined, but showed no evidence of disease. The abdomen was closed in layers.

The patient had some abdominal distention and a good deal of vomiting after the operation, but was relieved by enemata on the fourth day. His condition then began to improve, and he was discharged in apparent good health on Aug. 4, his only complaint being a feeling of fullness after meals.

FURTHER PROGRESS.—Aug. 22. Boy looks the picture of health, and is free from pain. Nothing abnormal can be detected on abdominal examination.

Sept. 25. The child complains of crampy pain all over abdomen, worse after a meal. The patient has lost flesh and colour. The abdomen is distended and tympanitic. Indistinct lumps can be felt through the abdominal wall. Per rectum, two large, firm, rounded masses can be felt, one in front and one on the right side, apparently adherent to the pelvic wall.

Oct. 17. The mother reports that the child is too ill to attend at the Hospital. He has lost much flesh and colour, suffers from thirst, has pains in the lower abdomen, and watery diarrhœa. His feet, legs, and scrotum are swollen.

The patient died at home on Oct. 23. A post-mortem examination was not obtained.

Comments.—The points of importance in the case are :—

1. Sarcoma of the small intestine is very rare, especially in children. Corner and Fairbank[1] collected 103 cases from the literature. Of these, 65 (63 per cent) were present in the small intestine, the largest number being in the ileum, and 38 (37 per cent) in the large intestine. The age of greatest frequency in the small intestine was between 30 and 40 years. W. Maxwell Telling[2] describes a case, similar in some respects to the present one, in a boy, age $3\frac{1}{2}$ years.

2. The situation of the growths in close association with the vessels at the mesenteric border raises the suspicion that they were embolic and

secondary to an unrecognized primary growth elsewhere, possibly in the pelvis, where, later in the case, large tumours were discovered apparently growing from the pelvic bones.

3. The presence of an intussusception of the small intestine, due to the growth.

4. The recovery after enterectomy on two occasions, within two months, in a young child.

5. The complete restoration of the bowel as seen two months after an end-to-end anastomosis.

Although both these operations were quite futile as regards ultimate recovery, they gave temporary relief and prolonged life, and at least satisfied the friends of the patient that everything had been done to save him. The second operation was perhaps hardly worth while, having regard to the state of affairs found at the first.

REFERENCES.

[1] CORNER and FAIRBANK, "Sarcomata of the Alimentary Canal", *Trans. Pathol. Soc.*, 1905, lvi.

[2] TELLING, W. MAXWELL, *Proc. Roy. Soc. Med.*, 1920, xiii, No. 9.

HYPERNEPHROMA OF GALL-BLADDER: CHOLECYSTECTOMY.

BY WILSON TYSON, LOWESTOFT.

WITH A REPORT ON THE SECTIONS BY A. PINEY, LONDON.

As there does not appear to be any record of a growth of the gall-bladder presenting the structure regarded as typical of a hypernephroma, the notes of the following case may be of interest.

Mrs. C., age 63, for the last nine months has complained of flatulent dyspepsia, with discomfort and occasional attacks of pain in the right upper abdomen, apparently not sufficiently severe to be typical of gall-stone colic; there has been no jaundice or urinary symptoms.

EXAMINATION.—On Aug. 6 I was asked to see her because of an attack of pain in the upper abdomen. There was a tender, hard swelling to be felt below the right costal margin which was considered to be an enlarged gall-bladder; there was no other abdominal swelling, and no evidence of a tumour in either lumbar region. The urine was free from blood, albumin, pus, or bile. Operation was advised.

OPERATION.—On opening the abdomen by a right upper paramedian incision, the gall-bladder was found to be the seat of a growth somewhat irregular in outline; the liver was smooth, and to the naked eye free from growth; no other abnormality was found in the upper abdomen. The cystic duct where it joined the common bile-duct appeared normal in size; the gall-bladder, which was free from adhesions, was removed, a tube was passed down to the ligated end of the cystic duct, and the abdominal wound closed. No gall-stones were found.

Progress was normal. At the present date (March 19) she is free from pain and is putting on weight.

DESCRIPTION OF THE SPECIMEN.—On section the gall-bladder was a mass of growth; the cystic duct was distended near the gall-bladder, but at its junction with the common duct appeared normal. *Fig.* 497 shows the gall-bladder on section, about half size, after hardening. Portions of the growth were sent to the Clinical Research Association, and the report was as follows:—

FIG. 497.—Appearance of the gall-bladder on section.

"*Section A*: The section shows blood-clot and eroded tissue surrounding a nodule of malignant new growth which is of the type usually described as a hypernephroma.

"*Section B*: Nearly the whole of this tissue is malignant, showing the peculiar clear cells which are observed in *Section A*. At its margin is a small portion of liver tissue; the parenchymatous cells show fatty degeneration and the surrounding fibrous tissue is increased in amount. A small strip of necrotic tissue at the opposite pole shows bile staining, and evidently indicates the lumen of the gall-bladder."

I have submitted the sections to Dr. A. Piney, Director of the Institute of Pathology, Charing Cross Hospital, who has been good enough to have the photomicrograph done and has given me permission to append his comment on the case.

REPORT ON SECTIONS OF 'HYPERNEPHROMA' OF THE GALL-BLADDER (A. Piney).—The histological characters of this tumour are identical with those described as being typical of hypernephroma by Grawitz[1] in 1883. No portion of gall-bladder can be identified in the sections, but at one side there is a small portion of liver. The histological characters of the tumour are seen in *Fig.* 498, and the clear cells with distinct walls supported by a fibrous stroma cannot be confused with those of any other neoplasm.

The present tendency is to regard renal hypernephromata as being derived from altered kidney-cells, and there can be no doubt that true adrenal rests in this

FIG. 498.—Section of 'hypernephroma' from gall-bladder. The extremely clear cytoplasm with distinct cell walls is clearly shown, as is also the fine supporting fibrous stroma. (× 150.)

organ are far from common, although the theory that hypernephromata grow from such structures would presume their comparatively frequent presence.

Adrenal rests are extremely common in some situations, e.g., along the spermatic cord, in the broad ligament, and on the under surface of the liver, but no record of such a structure in the wall of the gall-bladder is available.

Borst[2] is still strongly of the opinion that the majority, if not all, hypernephromata are of adrenal origin, and there is much to support this view; if it be accepted, the explanation of the genesis of the present tumour would not present insuperable difficulties. The neoplastic growth either of an adrenal rest in the liver near to the gall-bladder or of such a rest in the wall of the latter organ would well account for its occurrence.

REFERENCES.

[1] GRAWITZ, P., *Virchow's Arch.*, 1883, xciii, 39.
[2] BORST, M., *Aschoff's Pathologische Anatomie*, 1923, i, 755.

FUSIFORM DILATATION OF THE DUODENUM SIMULATING HOUR-GLASS STOMACH.

BY JOHN MORLEY, MANCHESTER.

THE condition of the duodenum encountered at operation in the case recorded below presents such interesting features, and is of such striking rarity, that it is considered worthy of publication.

A married woman, age 61, was referred to me in December, 1924, by Dr. J. A. Lees, of Rawtenstall, on account of gastric trouble. She gave a history of pain in the stomach for the past ten years, at first intermittent but for the past few months continuous. The pain would commence about five minutes after food, and last for several hours. It was so severe that she often applied hot flannels to the abdomen. Some relief was given by alkalis. There had been no vomiting and no hæmatemesis. The appetite had been conspicuously poor for many weeks. Of late she had suffered from alternate constipation and diarrhœa, and during the last six months she had lost weight considerably. An X-ray examination five years before had shown 'an ulcer on the stomach'.

EXAMINATION.—The patient was a thin woman, of sallow complexion, with typical *habitus enteroptoticus*. Examination of the abdomen revealed marked gastroptosis associated with a tender spot in the mid-line just above the umbilicus. Both kidneys were movable.

On clinical grounds the case was regarded as one of gastroptosis associated with general splanchnoptosis, with possibly a gastric ulcer in addition. She was referred to Dr. R. S. Paterson for X-ray examination, and he reported as follows: "The screen examination in this case showed the stomach lying extremely low, the pylorus being at the level of the 5th lumbar vertebra. There is, however, in addition to this, what appears to be an organic hour-

glass condition of the stomach with a small sac at the pyloric end (*Fig.* 499). There was a small filling defect in the constricted area between these two sacs. Examined five hours after an opaque meal, a delay was seen in both sacs. Food could be pushed from one sac into the other. Nothing abnormal was seen in the small intestine. The colon was lying very low, both the hepatic and splenic flexures being well below the line of the iliac crests."

After this examination I advised operation on the ground that, in addition to the enteroptosis, the patient was suffering from hour-glass contraction of the stomach resulting from chronic ulcer.

OPERATION, Jan. 13, 1925.—Under ether anæsthesia an incision was made in the mid-line above the umbilicus. What appeared at first sight to be a

FIG. 499.—Showing barium in stomach (right sac) and dilated first part of duodenum (left sac).

typical hour-glass stomach was disclosed. The healed scar of a small ulcer was found on the lesser curvature about two inches above the constriction between the two sacs. On examining the outlet of the large distal sac, no pyloric ring could be found, but the sac terminated abruptly in the second part of the duodenum, which ran downwards in front of the right kidney. This part of the duodenum was unusually narrow and empty, but otherwise healthy. It was now realized on closer inspection that what appeared to be the distal sac of an hour-glass stomach was actually the first portion of the duodenum, which had undergone an extreme degree of fusiform dilatation. The waist of the apparent hour-glass stomach was formed by the pyloric ring, which showed no pathological change beyond some slight hypertrophy of the circular muscle coat. The narrowing of the second or descending

portion of the duodenum appeared to be due to the pressure of the movable right kidney. The kidney was rather more rotund and firmer than usual, and could be drawn downwards and inwards on the psoas shelf with great ease, when it pressed the second part of the duodenum forward and appeared to obstruct it. It was evident that in the upright position this pressure on the duodenum from behind by the movable kidney must be exerted continuously.

A posterior gastrojejunostomy was performed in the usual manner, and in addition an anterior duodenojejunostomy was performed on the front of the dilated portion of the duodenum. On account of the frail condition of the patient, nephropexy was not considered advisable.

Convalescence from the operation was uneventful. The patient was fitted with a corset-belt for the splanchnoptosis, and four months later reported that her health was improving very satisfactorily.

IMPLANTATION DERMOID OF THE TERMINAL PHALANX OF THE THUMB.

By HAROLD BURROWS, C.B.E., Portsmouth.

The patient, an engineer, age 47, was sent to me by Dr. C. M. G. Elliott in February, 1925.

History.—When a boy of about eleven or twelve years he ran a piece of wire deeply into his left thumb. He cannot say whether the wire went into the bone or not; but when the wound healed it left a depression in the skin at the point of entry, and this little crater remained as a permanent mark. He does not remember of what kind the wire was or any other details. The depression left in his thumb was of about $\frac{1}{16}$ in. diameter and $\frac{1}{32}$ in. deep, and was situated on the ulnar side of the thumb towards the tip. About twelve months before the present accident he noticed that the end of his left thumb was swollen. Four months previously to my seeing him, a piece of metal had fallen on his left thumb, which had been tender and painful ever since, so that he had been quite incapacitated from work; there was no surface wound, and the nail had not exfoliated.

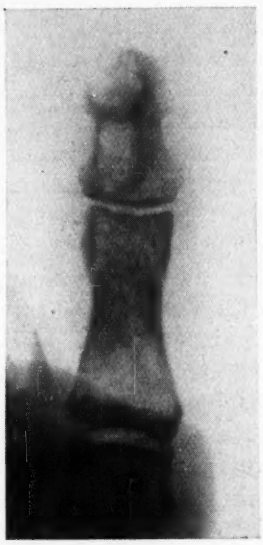

Fig. 500.—Skiagram showing appearance of terminal phalanx of the thumb.

On Examination.—When first seen by me the terminal half of the thumb was considerably swollen and reddened; it was hot to the touch, very tender and painful, and the patient said that it was always throbbing. An X-ray photograph taken by Dr. Beverley Bird showed a curious irregular vacuolation of the terminal phalanx (*Fig.* 500).

Operation.—On Feb. 24 I made a lateral incision in order to expose the terminal phalanx, but on cutting through the skin I immediately came down upon a mass of white material

resembling lanolin. It was of a purer white than the sebum found in a sebaceous cyst. This material almost completely surrounded the phalanx, and was not enclosed by any cyst wall. To attempt any palliative measures seemed unpromising, so I removed the terminal phalanx of the thumb, and covered the stump with a palmar flap.

On subsequent examination the phalanx was found to be occupied by a single ramifying cyst which had a white glistening lining, some of which was sent to Dr. Radcliffe for microscopical examination. His report is as follows: "The cyst wall is formed by dense, almost acellular, fibrous tissue, lined by a stratified epidermis which shows a prickle-cell layer and stratum granulosum, but there are no papillæ. It suggests an implantation dermoid."

The operation revealed no sign of pus.

It seems clear that the patient was suffering from an implantation dermoid cyst in the terminal phalanx of his thumb; that the cyst had become ruptured by direct injury, and that the diffusion of its contents among the soft tissues of the thumb had caused a persistent, painful inflammatory reaction leading to disability.

The patient now has a healthy painless stump, and he says that he is hardly incapacitated at all. What he chiefly misses is the thumb-nail.

REDUCIBLE HERNIA OF A LIPOMA OF THE KNEE-JOINT.

By W. SAMPSON HANDLEY, London.

Lilian S., age 25, was admitted to the Middlesex Hospital under my care, with a history that nine months previously she had fallen downstairs, bruising the outer side of the left knee, which has since been the seat of pain. On examination a soft semifluctuant rounded swelling was to be felt under the skin opposite the upper edge of the tibia and just on the outer side of the ligamentum patellæ. It was of about $1\frac{1}{4}$ in. diameter, circular in outline, and flattened in the plane of the skin. Its edge could be felt to slip from under the finger, and the skin was freely movable over it. On its deep aspect the swelling appeared to be fixed. On flexion of the knee the swelling disappeared almost completely, re-appearing suddenly when the joint was again extended. The swelling was thought to be a Morrant Baker's cyst.

On Dec. 8 an incision 2 in. long was made over the swelling, which proved to be a lipoma. It was found to have a pedicle which, entering a small, round, sharply defined hole of $\frac{1}{3}$ in. diameter in the capsule of the knee-joint, was continuous with a lipomatous mass behind the ligamentum patellæ. Through this opening, in flexion of the joint, the soft lipoma reduced itself into the subsynovial tissue. The opening was enlarged, and a well-defined lipoma was shelled out, the capsule being then sewn up. The patient made an excellent convalescence, and her symptoms were relieved. She was discharged a fortnight after operation. It must remain uncertain whether the injury took any share in causing the abnormal opening in the capsule which permitted the formation of the subcutaneous portion of the lipoma.

LARGE SALIVARY CALCULUS WHICH HAD UNDERGONE SPONTANEOUS FRACTURE LEADING TO EBURNATION OF THE BROKEN SURFACES.

By Sir JAMES BERRY, London.

This calculus, which I recently removed from a lady, age 46, seems worthy of record, not so much on account of its large size, but because of the peculiar spontaneous fracture which it had undergone long before it was removed.

Twenty-nine years ago, at the age of 17, the patient had first observed a swelling in the right submaxillary region, especially noticeable while she was eating and when she had a cold. For several years she had been aware of a hard lump in the floor of the mouth on the same side. As it gave her but little inconvenience she paid no attention to it until her dentist advised her to see Dr. Hardy Fleetwood, of Hadleigh, who at once passed her on to me.

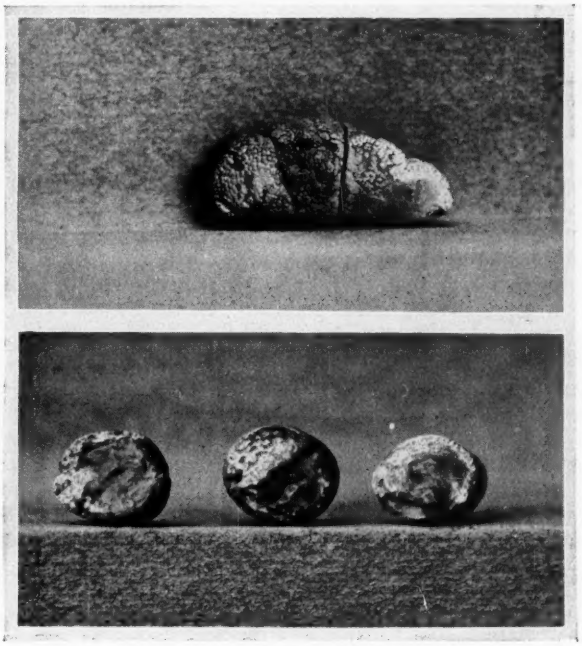

Fig. 501.—Showing lines of fracture of salivary calculus and eburnation of broken surfaces.

The calculus was removed without any difficulty through an incision in the floor of the mouth. It was lying at the anterior end of the submaxillary duct. It was then found to have been broken spontaneously into three nearly equal portions. There had been, however, very little displacement of the fragments, which must have been gripped tightly by the duct in which they lay. As the upper illustration shows (*Fig.* 501), the fragments when fitted together preserved the original shape of the calculus. The very slight amount of movement taking place over a long period of months or years had led to a polishing or eburnation of the opposed surfaces. This condition, common enough in the cases of biliary and prostatic calculi, is, so far as I know, extremely rare in the case of salivary calculi. There was no clinical evidence of the date at which the calculus broke, but it must have been at least many months, or more probably years, before its removal.

The calculus weighed 3·11 grm. Its length was 29 mm. ($1\frac{1}{8}$ in.) and its greatest diameter 12 mm. ($\frac{1}{2}$ in.). It is now in the Museum of the Royal College of Surgeons (No. E. 28), which contains no similar specimen showing eburnation of the fractured surfaces of a salivary calculus.

REVIEWS AND NOTICES OF BOOKS.

Manipulative Surgery: Principles and Practice. By A. G. TIMBRELL FISHER, M.C., F.R.C.S., Surgeon with charge of Out-patients, Seamen's Hospital, Greenwich. Demy 8vo, pp. 168, with 62 illustrations. 1925. London: H. K. Lewis & Co. Ltd. 7s. 6d. net.

THIS small book represents a laudable endeavour to rescue from mysticism and irregular practice the sound principles of curative manipulation, the value of which has been recognized by such great pioneers as Hunter, Hilton, Paget, and Thomas.

There are three great classes of cases for which manipulation is indicated. These are conditions of adhesion in or round the joints, functional conditions, and subluxations. An accurate and careful account of all the large joints is given, including the special disabilities and the normal range of movements. Greatest attention is paid to the knee, because this joint is so liable to obscure forms of derangement. Probably many of the most successful bone-setters have achieved their results by a combination of shrewd instinct with strong psychic force, and unfortunately neither of these things can be described, much less imparted, by a printed page. Bone-setters appear never to write books or articles descriptive of their methods. They prefer to be written about in the newspapers, and to allow it to be hinted that they are in possession of a profound secret. Mr. Fisher does well to expose the principles of manipulation to light and reason. If in the next edition he could persuade a certain eminent bone-setter and knight to write an appropriate foreword, it would greatly add to the interest of his pages.

Abdominal Operations. By SIR BERKELEY MOYNIHAN, Bart., K.C.M.G. In two volumes. Fourth edition, revised. Royal 8vo. Pp. 1217, with 450 illustrations. 1926. London and Philadelphia: W. B. Saunders Co. Ltd. 90s. net per set.

As this book is so well known that it has justifiably reached its fourth edition a set review of it is unnecessary.

No surgical book has yet been written or will be written which is perfect throughout. This, however, is so good and without a rival that we should like to see it better. Those chapters which are the result of the author's vast experience, in which he gets away entirely from the many names that clog others and in which he is dogmatic, could not be better. In some cases symptoms and diagnosis are fully dealt with—for example in acute pancreatitis and in the preliminary observations upon cholelithiasis. In the latter etiology is discussed fairly fully, while it is only very shortly dealt with in the case of gastric ulcer. In the chapter on visceral prolapse we are left without any guidance as to the symptoms and when, if ever, any of the operations mentioned should be performed. The time has come when many of the early references might be omitted; this would provide space to give more fully the opinions of British writers.

We consider this work unrivalled among books on abdominal surgery, and can only express a hope that in future editions we shall have more of the decided opinions of Sir Berkeley Moynihan and more guidance in the border-line cases.

The Diagnosis and Treatment of Tuberculosis of the Hip. By G. R. GIRDLESTONE, B.M. (Oxon), F.R.C.S., Hon. Surgeon, Wingfield Orthopædic Hospital, Oxford. Demy 8vo, pp. 94 + x, with 60 illustrations. 1925. London: Humphrey Milford. 8s. 6d. net.

THIS small book is purely clinical in its scope. An endeavour is made to impress the importance of early diagnosis upon the general practitioner, and to enforce the rule that early suspicious cases should be sent without delay to special institutions

for more detailed examination, instead of allowing time to slip by so that the favourable period for treatment is past. The inclusion of a few cases of pseudo-coxalgia or coxa vara among those sent to hospital does no harm, whereas the postponement of admission of tuberculous hips until bony changes are advanced is a mistake that cannot be remedied. The symptom of limping alone should be enough to indicate rest and further investigation, even if the X rays show no change.

Operation has no place in the treatment of the disease in children, except for the evacuation of an abscess or for the correction of late deformity. Operations for fixation or mobilization are reserved for special cases in adults. The Jones frame is advocated for all cases in the first or active stage of the disease, which is said to be anything from three to twelve months in duration. Details about the fitting and adjustment of the frame are omitted, and we think this is unfortunate, because it is just these details which one looks for in a practical book of this sort. Another aspect, too, we think might be discussed more fully, and that is the methods to be pursued in the case of those patients who cannot receive the ideal sanatorium treatment. The book is excellently illustrated by skiagrams.

Pitfalls of Surgery. By HAROLD BURROWS, C.B.E., M.B., B.S. (Lond.), F.R.C.S., Surgeon, Gosport War Memorial Hospital, etc. Second edition (formerly "Mistakes and Accidents of Surgery"). Demy 8vo. Pp. 525 + x. 1925. London: Baillière, Tindall & Cox. 12s. 6d. net.

THE author and publishers make a strong point of the change of title of this book; but in our opinion the fault does not lie with the title, but with the material it contains. It is such a medley of symptoms, fragments of pathology, and stories of mistakes that we think it is more likely to alarm than to instruct a beginner. One must, however, admit that the motive which has compelled the author to write what is largely a *confessio medici* is supremely altruistic; but many of the dangers and difficulties which are laid stress on seem to us those of twenty-five years ago rather than of to-day, when much experience of so many operators, and a wider knowledge of the pathology of the living, has rid us of many old-time bogies. In fact, one must realize that surgery is too large a subject to be dealt with in a volume such as this, and there are few authors who under the circumstances, dealing with a single aspect of the subject, could avoid being superficial; so that it cannot be urged as a great failing in Mr. Burrows, if, with the best motives in the world, he has made no serious addition to surgical literature.

Hand Atlas of Clinical Anatomy. By A. C. EYCLESHYMER, B.S., Ph.D., M.D., Dean of the College of Medicine and Director of Department of Anatomy, College of Medicine, University of Illinois; and TOM JONES, B.F.A., Director of Anatomical Illustration and Instructor in Anatomy, College of Medicine, University of Illinois; with special dissections by O. E. NADEAU, B.S., M.D., Associate in Surgery, University of Illinois. Royal 8vo. Pp. 420 + viii, with 395 illustrations, mostly in colour. 1925. London: Henry Kimpton. 50s. net.

THE best atlas for the study of anatomy is undoubtedly the human body; but in the absence of actual dissections and of the second-best alternative, a large atlas, a hand atlas such as this serves an exceedingly good purpose, though it will be at once admitted that it is impossible to portray any detail of the dissection of the chest or abdomen in a drawing 5 in. by 7 in. The subjects for the drawings and diagrams are well chosen, and, if not particularly selected with a view to their surgical importance, yet there are few which would not be of value to a surgeon. We think the explanatory index of eighty pages a mistake, and should have preferred that the space had been allotted to further diagrams and drawings: the value of such an atlas to a student of anatomy is to supply him with a pictorial illustration of the structures he is reading of in his anatomical text-book, and therefore, in our opinion, such an index is unnecessary.

St. Bartholomew's Hospital Reports. Vol. LVIII. Demy 8vo. Pp. 113 + xx. 1 London: John Murray. 21s. net.

THIS volume contains obituary notices of Klein, Tooth, and Williamson, all written with sympathy and discretion. An article by C. L. Hewer on splanchnic analgesia gives a valuable record of nineteen cases; it is claimed that the shock of large abdominal operations was diminished, but in every case the patient was kept under very light general anæsthesia. Mr. Rawling contributes a very candid description of a case of trigeminal neuralgia which is full of both humour and precepts for those who would learn therefrom.

Scoliosis: Rotary Lateral Curvature of the Spine. By SAMUEL KLEINBERG, M.D., F.A.C.S., Assistant Surgeon, New York Hospital for Ruptured and Crippled: Chief of Orthopædic Service, Israel Zion Hospital of Brooklyn, etc. Medium 8vo. Pp. 311+xvi with 140 illustrations. 1926. New York: Paul B. Hoeber, Inc. $6 net.

THE voluminous literature on scoliosis has tended to enshroud this common deformity in mystery. The author of this monograph has endeavoured to present the subject in a simple fashion, and it must be admitted that he has achieved his object.

In the opening chapters the relation of lateral curvature to the general body mechanism is well emphasized, and particularly its influence on the psychology of the deformed patient. It would be interesting to know whether there is any diminution in the incidence of this deformity as seen in special hospital out-patient departments in the United States. In Great Britain there seems to be no doubt that scoliosis is on the decrease.

In any work on lateral curvature the section on etiology is always apt to be very disappointing to the reader. Dr. Kleinberg gives a brief review of the accepted theories, and with others is compelled to put the incidence of the so-called idiopathic type as 85 per cent. In this group of cases, however, a radiological study of the spine carried out by Buchman, working in the same clinic as the author, has revealed the very frequent existence of osteochondral changes in the epiphyses of the vertebral bodies. The exact significance of such changes cannot be defined at present.

The symmetrical developmental exercises described in the chapter on gymnastic treatment appear rather old-fashioned from the British point of view. The asymmetrical corrective exercises, however, are dealt with more effectively, and should prove a useful guide to the uninitiated.

No extravagant claims are made for the results of forcible correction of fixed scoliosis, but a judicial account of the various methods is presented. The author favours the application of the corrective jacket with the patient in suspension, and from a considerable experience of this method believes that 55 per cent of the cases show definite improvement.

A good account is given of the operative treatment of scoliosis which has been tried fairly extensively during recent years in the clinic of Royal Whitman, work in which the author has collaborated. The technique followed has been spinal fusion over a fair-sized area with the use of a beef-bone graft. In a limited group of cases the results obtained have been quite satisfactory, but the method is still in the experimental stage.

Surgery of the Stomach and Intestines. By J. SHELTON HORSLEY, M.D., Attending Surgeon, St. Elizabeth's Hospital, Richmond. Surgical Monographs, under the editorial supervision of Dean Lewis, A.B., M.D., Professor of Surgery, Johns Hopkins University; Eugene H. Pool, A.B., M.D., Attending Surgeon, New York Hospital; and Arthur W. Elting, A.B., M.D., Professor of Surgery, Albany Medical College. Imperial 8vo. Pp. 325 + xvi, illustrated. 1926. New York and London: D. Appleton & Co. 21s. net.

MANY books have been published on the surgery of the stomach and intestines, but this volume takes the unusual course of treating these subjects from a physiological aspect. The author says in his preface that the large amount of space devoted to physiology requires some explanation. In our opinion it certainly needs

apology. Physiology is the science of function, and the true ideals of an operation are to remove or correct pathological conditions and to restore as far as possible the physiological functions. How can we do this without a knowledge of the normal workings of the stomach and intestines? Heretofore anatomy has had an almost tyrannical influence over surgery, and we welcome a book which gives to physiology a position of at least equal prominence, and especially when written by so able an author.

The work begins with a chapter on the embryology, and this is followed by another on the anatomy, of the stomach and intestines; there is nothing new in these. Chapter 3 deals with physiology; here the points relative to the proper surgical manœuvres required for the varying pathological conditions are emphasized. The work of many researchers is reviewed, especially that of Alvarez, who by ingenious devices has advanced theories on peristalsis which, though at variance with those of many others, seem to explain clinical phenomena more satisfactorily.

Chapter 4 deals with diagnosis. This chapter is contributed by Dr. W. Higgins, Attending Physician to St. Elizabeth's Hospital, Richmond. He states that the modern conception of gastro-intestinal physiology has brought about radical changes in our interpretations of symptoms arising from these organs. We are indebted chiefly to Carlson and Alvarez for demonstrating the fallacies and unsupported dogmas of former views on this subject.

In Chapter 5 general considerations are dealt with relating to the operating room, anæsthesia, frozen sections, shock and hæmorrhage, and blood transfusion.

Chapters 6 to 15 inclusive are devoted to specific lesions and the appropriate treatment. The author states that an effort has been made to base operations and procedures as far as possible on biological principles, and only those which seem to have such a foundation have been adopted. For example, the work of Dragstedt is very suggestive in showing that it is important not to catch the pyloric portion of the gastric mucosa in the grasp of the suture if it can be avoided. He has demonstrated that one of the most satisfactory methods of establishing an experimental peptic ulcer in the pyloric portion of the stomach of a dog is to insert sutures in the mucosa at one given spot. Towards the cardiac side ulcers are more difficult to create. The author is averse from the use of clamps whilst making an anastomosis, and to ensure a complete mucous covering to the line does not remove any mucosa, and carefully everts this coat, taking special precautions to approximate only and not to crush it by overtightening the sutures, as this would cause sloughing. He uses a lock-stitch very extensively. These points are emphasized with the object of preventing jejunal ulcer, and though we believe these ulcers, following gastro-enterostomy, are more frequent than the 2 per cent usually stated, we cannot agree with Lewishon, whom the author cites, when he says that fully one-third of the gastro-enterostomies done with the usually accepted technique are followed by jejunal ulcer.

In Chapter 16 we have a résumé of the more important research conducted on intestinal obstruction, with especial emphasis laid upon the recent work of Foster and Hausler, and of Haden and Orr. The work of the latter two, dealing with the loss of chlorides of the blood in high intestinal obstruction, promises to have far-reaching effects upon the treatment of this condition. The book terminates with a short chapter on special causes of intestinal obstruction.

A brief bibliography is placed at the end of each chapter. The author says that it is not intended to make this a complete bibliography; only the principal articles or books consulted are given. It seems profitless, he adds, to compile an unnecessarily long list when in these days of accumulative indexes all references can be easily found.

The book is one to be thoroughly recommended. The emphasis given to the physiological aspect of surgery is, in our opinion, of the greatest importance, and the surgery of the future will undoubtedly be much advanced and put on a sounder footing by paying more attention to physiological principles. In this respect orthopædic surgery is a long way ahead of general surgery; but, as this book shows, there are many principles of physiology which have a very direct bearing on the surgery of the stomach and intestines, but are not as yet put into general practice.

Fractures of the Humerus, Radius, and Ulna. By ELDRIDGE L. ELIASON, A.B., M.D., Sc.D., F.A.C.S., Professor of Clinical Surgery in the University of Pennsylvania Medical School, with the collaboration of RALPH GOLDSMITH, M.D., and EUGENE P PENDERGRASS, M.D., both of the University of Pennsylvania. Imperial 8vo. Illustrated. 1925. New York and London: D. Appleton & Co. 21s. net.

THIS volume, one of a series of surgical monographs edited by Drs. Dean Lewis, Pool, and Elting, will prove of special value to those interested in the statistical aspect of fractures, but in many other aspects it is full of interest. The best feature of the volume is the illustrations, which are well chosen and well executed, even if some of the X-ray productions are too small to be clear. The letterpress, which is in a sense subordinate to the illustrations, loses something of its grasp on the memory of a reader by a tendency to excessive classification and production of lists, but everything that is written is clearly founded on personal clinical experience; particularly are the authors definite whenever possible on the question of causation, and one notes with joy that many of the fairy tales which often appeared in surgical writing on fractures from our youth up obtain no place in this volume.

The chapters that have pleased the reviewer most are those dealing with the injuries in the region of the elbow-joint, but the authors do not give due importance to the possibility of secondary Volkmann's contracture, and say little about its prevention; incidentally it is difficult to agree with their statement that it produces a claw-hand, in which we have always been taught the metacarpophalangeal joints are extended, a condition typical of paralysis of the ulnar and median nerves. There are several points in treatment not in agreement with habit in this country, of which perhaps the most marked is the suggestion that the right line of treatment for a fractured olecranon is by splinting, and exceptionally by operation. Again, the authors advise treatment of certain fractures of the forearm in the thumb-up position, a practice which has fortunately disappeared in this country; yet they realize, on p. 273, that supination will be the motion most limited, and in the very next paragraph to that advocating the above-mentioned, and in our opinion misguided, advice, there is a remark so full of truth and of such great value for treatment of fractures in any part of the body that it might be written as a text at the head of each page in such a book as this: "Do not be bound by any rule with regard to . . . position. Dress it in that position and with that fixation that holds it best as shown by the fluoroscope"; with large-minded progressive views like this there is no doubt that the authors in a future edition will have material which will enable them to strike out the paragraph to which exception has been taken.

The last chapter deals with operative treatment, and is altogether on a lower plane of excellence than the rest of the book; for instance, no mention is made of the value of operative treatment when an articular extremity of a bone is involved. There are many cases depicted in this book of fractures similar to this; yet in two years only ten simple fractures have been treated by them by open operation. It is hoped that in the near future wider experience of the value of open operation, combined with the perfected use of an internal splint, such as the Lane plate, will be sought, when those surgeons who have as great opportunities of doing good work as have the workers in this fracture clinic will not any longer hold the opinion that "internal splint fixation is nothing more than the flimsy make-shift at the best, and that absorption soon loosens wires and screws".

L'Anatomie en Poche. By Dr. VICTOR PAUCHET and S. DUPRET. Crown 8vo. Pp. 316, with 297 illustrations. 1925. Paris: Gaston Doin et Cie. Fr. 25.

DR. PAUCHET, whilst teaching anatomy and operative surgery at Amiens, designed this small work, and Dupret has carried out his ideas by a series of excellent diagrams. Each page, measuring 7 in. by 4½ in., is occupied by a clear, well-drawn diagram in black and white or in one colour. The drawing is surrounded by the names of all the structures shown. The whole human anatomy is thus dealt with in a small compass, and a most serviceable method is provided of refreshing the memory about intricate facts and names. We hope that this or a similar book may be provided for English readers.

Rejuvenation by Grafting. By Dr. SERGE VORONOFF, Director of the Department of Experimental Surgery of the Collège de France, etc. Translation edited by Fred. F. Imianitoff, B.A. Demy 8vo. Pp. 221, with 38 illustrations. 1925. London: Geo. Allen & Unwin Ltd. 15s. net.

THE author, in his introduction, says that between June, 1920, and October, 1923, he performed 52 testicular grafting operations, of which 43 grafts, all transferred from ape to man, form the basis of the observations set forth in the book. The ages of the subjects upon whom the grafts were made ranged from 22 to 75 years. The opening chapter recounts the development of the idea ensuing from observation of the physical and mental characteristics of eunuchs seen in Egypt. The effect of the internal secretion of the testes upon the organism is fully discussed. An interesting account is given of the earliest experiments, which were carried out upon old and useless rams by grafting portions of the testes of young rams into their scrotums. A photograph of an old ram before grafting is shown, and another of the same ram five years after the grafting had been performed. The difference in the appearance of the animal is very pronounced. In order to make sure that the transformation thus obtained was due to the stimulation of the ram's testicles by the presence of the grafts, the author carried out a further series of experiments in which young goats were castrated and grafted at the same time. The subjects of these experiments preserved their normal appearance and development, and also retained the sexual appetite. The author then goes on to say that the experiments of grafting portions of testes from one animal to another of the same species were so successful that he conceived the idea of experimenting on the human species. As it was impossible to obtain healthy human testes for the purpose of making grafts, he decided to make use of the testes of the anthropoid apes. He claims that the results of these experiments fully justify the operation in those individuals who are the subjects of testicular insufficiency. He asserts that increase in physical energy and improvement in mental capacity are marked, but insists strongly that the introduction of a testicular graft does not act as an aphrodisiac. The details of the operation are carefully described, as also are the means adopted in the preparation of the grafts.

The histories of 44 instances in which the operation was carried out in the human subject make interesting reading, and although in many cases marked improvement in physical and mental vigour became apparent for a time, the effect does not appear to have been lasting, and consequently one is left in doubt as to whether the game is really worth the candle.

Chirurgie der Sportunfälle. By Dr. FELIX MANDL, Assistant in the Second University Surgical Clinic, Vienna. Royal 8vo. Pp. 303, with 71 illustrations. 1925. Berlin: Urban & Schwarzenberg. M. 12.

THE author remarks on the rapid extension of sport in late years, especially after the war, and tells us that there are no fewer than 260 football clubs in and around Vienna, with about 60,000 active members. At first sight it does not seem very reasonable to make a special treatise dealing with accidents which arise in the course of sport; but an examination of these pages makes one realize that the author has more than justified his work. He begins with a general description of the type of injuries and the problems of treatment met with in those engaged in active sports, and then devotes a special chapter to the treatment of fractures of the extremities. Valuable suggestions are made for the improvisation of splints from Kramer's metal ladders; these, consisting of longitudinal wires with cross-struts, can be cut and bent for many purposes. There is a lamentable absence of all mention of the Thomas arm or leg splints, which we know so well to be of invaluable service in emergency work. The body of the book consists of a description of the injuries particularly likely to be associated with the different forms of sport. Football, hockey, jumping and running, tennis, duelling, boxing, swimming, riding, Alpine sports, motoring, and flying are among the sports considered, and in each section many facts of interest and importance are collected. We think that the value of the book will be increased if more attention is paid to special methods of 'first aid' which may be useful in emergencies.

Surgical Pathology. By WILLIAM BOYD, M.D., M.R.C.P. Ed., F.R.C.S., Professor of Pathology, University of Manitoba; Pathologist to the Winnipeg General Hospital, Winnipeg, 8vo. Pp. 837, with 349 illustrations. 1925. London and Philadelphia: W. B. Saunders Co. Ltd. 45s. net.

THE advent of this book fills a gap which has existed for years in a surgeon's library. To the reviewer the volume has been a constant source of enjoyment, and has been dipped into on innumerable occasions either for information on some particular pathological point, or out of curiosity to ascertain what the author's view might be on some question of examinational interest; the results of these inquiries have usually been inspiring and have never been disappointing.

Hitherto a volume on surgical pathology has rigidly excluded bacteriology, and an article on surgical bacteriology in a text-book usually deals with the subject from so specialized a viewpoint as to be unintelligible to the ordinary surgeon. Here we have bacteriology rightly recognized as a part of general pathology, and written up only to such a level as the surgeon requires and can understand. If one were to criticize the book it would be for the omission of much general pathological chemistry, such as calcium metabolism, the importance of variation in blood-sugar, and the general interdependence of the endocrine glands; these should be no less essential to an understanding of general pathological principles than, for instance, the chemistry of utility of thyroid secretions, on which is written one of the most instructive chapters of the book.

The volume is easy to read and convincing in tone, acquiring the latter quality because every page stamps upon one the conviction that it is written purely upon the author's experience, with no reference to or regard for what may have been the opinion of others or has appeared in other text-books. The author shows evidence of being well read in many matters which are strictly outside that of pure pathology, and his references are extremely well chosen and in every case modern. The illustrations are quite well selected, for typical common conditions are reproduced rather than those of extreme rarity; almost the sole exception is the drawing of anthrax pustules, in which the situation is not typical and the appearance by no means clear. The microphotographs are extremely well reproduced, and the general turn-out of the book is worthy of the high reputation of the publishers.

Traitement des Epitheliomas du Maxillaire supérieur par l'Association Chirurgie-Curiethérapie. By Dr. G. VERGER, Ancien Interne des Hôpitaux de Paris. Royal 8vo. Pp. 204, illustrated. 1925. Paris: Gaston Doin et Cie. Fr. 22.

THE book under review gives an excellent summary of the treatment of epitheliomata of the superior maxilla. The subject is considered from many aspects, and nothing of any importance is left out of the survey.

The author states that, considering the inefficacy of surgical treatment, it was natural to appeal to radiations in the struggle against cancer of the upper jaw. "It is the history of this endeavour as carried out at the Radium Institute of Paris, which we are about to retrace, and of which we are anxious to show the successive steps." They succeed admirably in the endeavour, and give an instructive résumé of the steps which led to the attainment of the ultimate technique. The achievement of the results detailed is an admirable tribute to Professor Regaud and his colleagues at the Radium Institute. The use of radium as an auxilliary to surgical procedures is clearly shown, and the value of this agent established on a sound foundation. The difficulties of radium therapy are dealt with. Of these, reference is made to two of capital importance: (1) infection, (2) bone necrosis following upon radium exposures. Two other complications are referred to which are peculiar to widespread cancer; they are hæmorrhages and glandular involvement.

In regard to deeply-seated infective processes, the difficulties are described in detail, and the conclusion arrived at is of great importance for the guidance of other workers in the treatment of cancer in these regions. "The only therapeutic agent for this condition is surgical interference on a large scale, free drainage of septic pockets to enable the radiations to act upon tissues relatively free from infection."

Radium bone necrosis is dealt with thoroughly. Much attention is given to the preparation of the site prior to the radium application, and the technique used by Hautart and Monod for packing the radium tubes in the region of the growth.

As regards dosage and quantity, the result of successive treatments with different doses has been to establish what quantity of radiation was necessary to obtain sterilization of the cancer without setting up a necrosis. The actual dose employed is one from 23 to 25 microcuries destroyed per hour in four days ; but more important still than the question of the total dose is that of the number of applicators. The same dose concentrated in a small number of applicators will have a disastrous local effect, and practically none on the distant parts ; whereas if many applicators are used over a large area, the result is much more satisfactory, the actual areas receiving a dose sufficiently intense to bring about reparative action. The conclusion is reached that the best dose is about 20 to 25 m.c.d. in four days. The quantity of radium to give this dose is placed in 11 to 12 tubes (the actual quantity in each is not stated, but it may be assumed that it is about 50 mgrm. of radium element).

By technique of this kind encouraging results are obtained, those in which the more recent technique has been employed giving relatively better results than in the earlier series. The work described in this admirable treatise is of the highest importance, serving to show that in the struggle against malignant disease it is only possible to obtain satisfactory results by the employment of a technique in which the highest surgical skill is available for collaboration with that of the radium expert.

We have nothing but admiration for the method in which the work has been done, and for the very honest statements of the author. Surgeons and radiologists may well ponder over the contents of this book ; they are bound to receive instruction and encouragement from its perusal.

Die Chirurgie : A System of Surgery. Edited by Professor KIRSCHNER (Königsberg), and O. NORDMANN (Berlin). Imperial 8vo. 1925. Berlin : Urban and Schwarzenberg. Fasc. 3, Vol. VI, pp. 228, with 60 illustrations and 10 coloured plates, M. 12 ; Fasc. 4, Vol. I, pp. 241, with 220 illustrations, M. 12 ; Fasc. 5, Vol. VI, pp. 521, with 108 illustrations and 4 coloured plates, M. 27.

FASCICULUS 3 forms a monograph on the liver and the pancreas. Professor Heller, of Leipzig, deals with the subject of the liver and biliary system. The sections on the embryology and anatomy are clear and well illustrated, whilst that about hepatic abscess is distinctly meagre, and out of proportion to the rest of the work. Theories of the etiology of gall-stones are dealt with at great length, and the subject is well illustrated, but it is strange that Rovsing's work is not mentioned at all. The X rays with regard to the diagnosis of gall-stones are rather inadequately described, and no mention is made of the bromine or iodine preparations of phenolphthalein in relation to this subject. The various operations and the choice of operative treatment for gall-stones and their complications are well and clearly described. The long list of references to literature contains no reference to Rovsing or Moynihan, and the latter is spoken of in the text as an American surgeon.

Professor Riese, of Berlin, writes about the pancreas, and he gives a good account of the anatomy, pathology, and surgery of this organ. The coloured figures in this section are very beautiful, but their interpretation is sometimes obscure. There is a good discussion on the etiology of acute pancreatitis, in which bacterial invasion and biliary infection both play a part.

Fasciculus 4 deals with a general study of injuries and wounds and their pathology and treatment by Professor Lotsch, of Magdeburg, and a description of artificial limbs by Dr. Böhm, of Berlin. The section on wounds is very clearly written, and is well illustrated by good microscopical and diagrammatic figures. The description of amputations and excisions is on conventional lines, and possibly greater emphasis might have been laid upon those few amputations which have been proved of service, rather than giving so many of the old classical types. Kinemaplastic amputations are discussed very briefly, and undue prominence is given to a difficult and useless bifurcation operation through the forearm. The section on artificial limbs calls for no special comment. The mechanical details of the upper limbs are unnecessarily complicated for a surgical treatise.

Fasciculus 5 treats of the affections of the kidneys, ureters, urethra, and testes. It is written by Professor Fraugenheim and Dr. Welmer, of Cologne. This forms a very full description of the surgery of the regions concerned, and it shows much more appreciation of foreign work, especially that of Albarran, than is the case in other parts of the system hitherto reviewed. There is a lengthy account of different methods of estimating renal function, but from a practical point of view we think that not enough emphasis is laid on simple methods. Ambard's constant and cryoscopy, both of blood and urine, we think might now well be forgotten, whereas more attention should be paid to the proportion and variation of the nitrogen constituents of the blood and urine. Dealing with movable kidney, the author supports the view that hysteria and other nervous instability form absolute contra-indications to operation. Some rather elaborate and fanciful methods of slinging the kidney to the last rib are described. Nephritis is discussed under a number of headings and varieties, and much attention is given to decapsulation, which seems to have a much greater vogue on the Continent than in this country. The sections on stone in the ureter are rather meagre and poorly illustrated. An ingenious method of plastic reconstruction of the urethra by Budde is illustrated, but otherwise the chapters dealing with the urethra, testes, and penis are on conventional lines calling for little comment. A long account is given of the operative precedures for undescended testes, without adequate consideration of the functional value or after-results of the procedure. This fasciculus is rather sparsely illustrated, and the figures seem to be very unevenly distributed, e.g., there are no fewer than twenty-three figures of operation for phimosis, but not a single illustration of new growths of the testes.

Schistosomiasis vel Bilharziasis. By C. G. KAY SHARP, M.D., Fellow of the Royal Institute of Public Health; Chief Medical Officer, Education Department, Province of Natal. With a foreword by Dr. J. B. CHRISTOPHERSON, C.M.G., M.D., F.R.C.P, F.R.C.S. Crown 8vo. Pp. 74 + v, illustrated. 1925. London: John Bale, Sons and Danielsson Ltd. 7s. 6d. net.

THIS little book is written mainly for the benefit of School Medical Officers and Educationists with a view to drawing their attention to the extent of the disease in Natal, its method of spread, and the means which should be adopted to control it. In the foreword Dr. Christopherson very rightly considers that the best ways of dealing with the problem are: (1) Mass treatment by antimony tartrate in schools and villages; and (2) Educational propaganda to check infection and re-infection.

A brief review of the history and nomenclature is followed by a chapter on etiology. In this the writer points out that in Natal urinary schistosomiasis is the commonest form, and that quite an appreciable number of European school children are affected. A useful map of Natal and Zululand is supplied, showing that, though most of the infected areas are near the coast, there are some from 100 to 150 miles inland. The intermediary hosts in Natal are the snails *Physopsis africana* and *Limnæa natalensis*. This chapter contains an excellent résumé of present-day knowledge, together with several useful illustrations and diagrams.

An account of the pathology and morbid anatomy is followed by paragraphs on immunity and incidence. The latter is perhaps one of the most useful sections in the book, for it contains a record of the writer's investigations, showing that in Durban, with 5000 male school children, 2·4 per cent were known to be infected, while in some native schools in other towns the infection was as high as 8 and 13 per cent.

In the chapter on diagnosis the writer describes his method of examining the urine for ova, which should be very helpful to practitioners. In suspected cases where examination has proved negative he points out that ova may sometimes be dislodged and found in the urine after the passage of a sound.

The recommendations for the prevention of the spread of the disease set forth in the section of prophylaxis are obviously based on considerable local knowledge, and should be very helpful to an M.O.H. in an infested district.

The final chapter contains a review of the treatment of bilharziasis in different parts of the world, but unfortunately does not include details of a scheme of treatment which the general practitioner could easily grasp and carry out. The book concludes with a long list of references to all important work on the subject.

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